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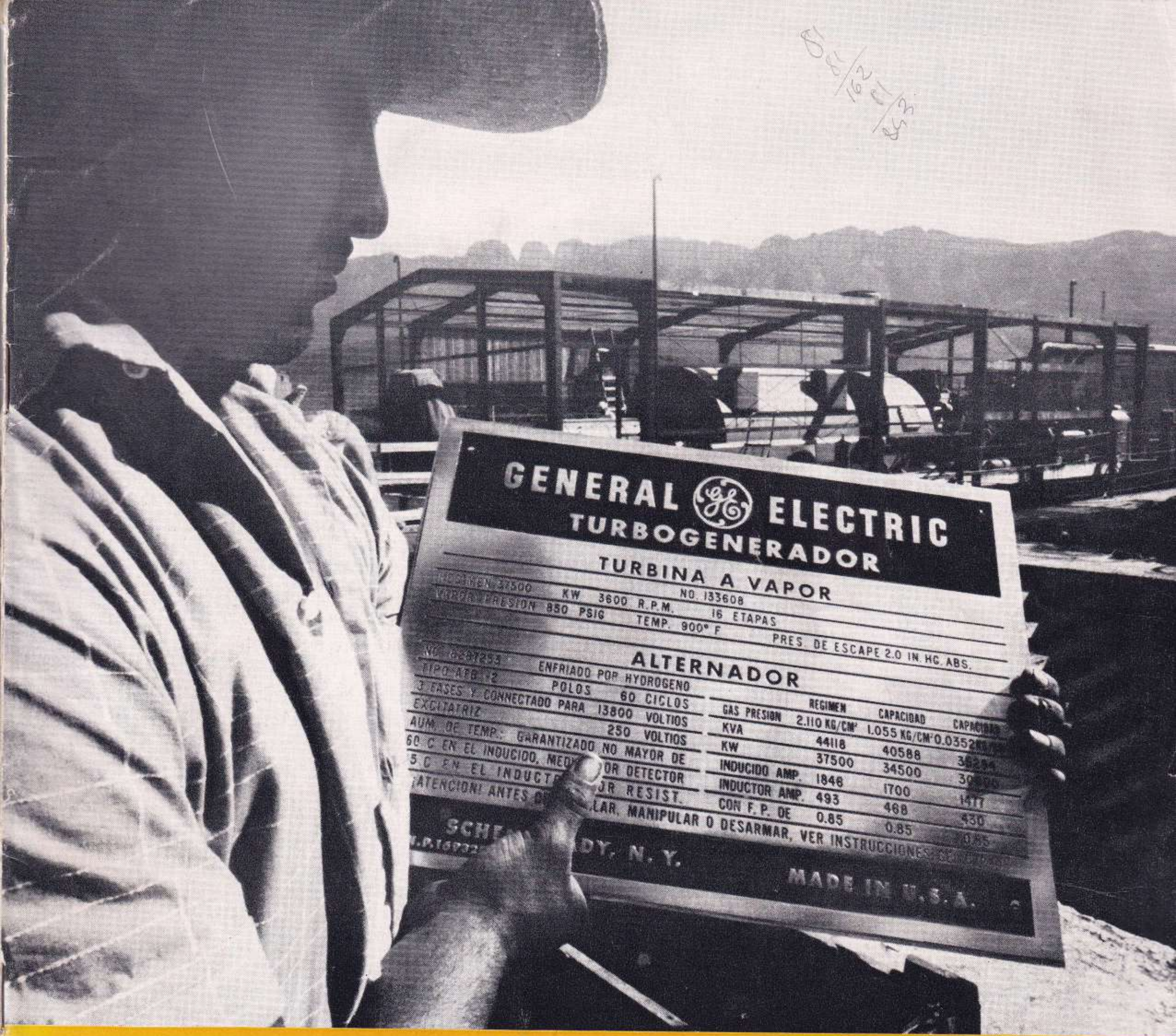

The Producer Goods
EXPORTER

INTERNATIONAL
GENERAL ELECTRIC
COMPANY
A DIVISION OF GENERAL ELECTRIC COMPANY, U.S.A.

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The Producer Goods
EXPORTER

THE PRODUCER GOODS EXPORTER is published quarterly by the Producer Goods Export Department of International General Electric Company, a Division of General Electric Company (USA). Its purpose is to provide readers with news and useful information on General Electric apparatus equipment and the activities of the Producer Goods Export Department.

THE EXPORTER is distributed free of charge to International General Electric distributors, to General Electric Subsidiary Companies overseas, and to IGE customers interested in more efficient use of electric power for greater productivity.

News contributions, comments, and change-of-address notices should be addressed to the editor, Room 737, 150 East 42nd Street, New York 17, New York.

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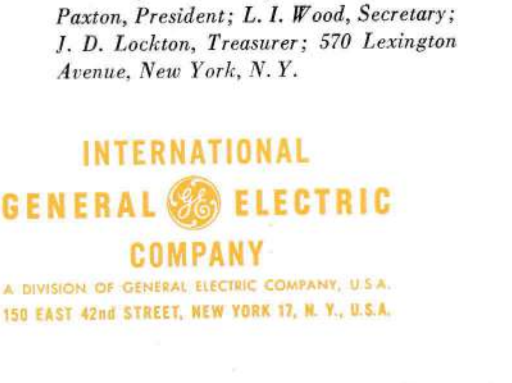


Mexican construction workers holds steam turbine-generator name plate for 37,500 kilowatt steam turbine-generator unit being assembled at San Jeronimo outdoor station near Monterrey, Mexico.

Why The System Approach

System: a group of units so combined as to form a whole and to operate in unison; an organized whole. (Merriam-Webster Dictionary)

More and more this word, "system" is becoming an important and frequent word in the language of the world's capital goods user. And, to reflect this importance, you will find this word also sprinkled quite liberally through this issue of the EXPORTER.

The significance of this word cannot be too readily emphasized in the growing pressure of competition, for it indicates to the listener one of the newest concepts in capital goods purchase, use, responsibility and service.

In the past many installations operated effectively when they were composed of equipment provided by a number of manufacturers and put together by the customer or his engineering firm.

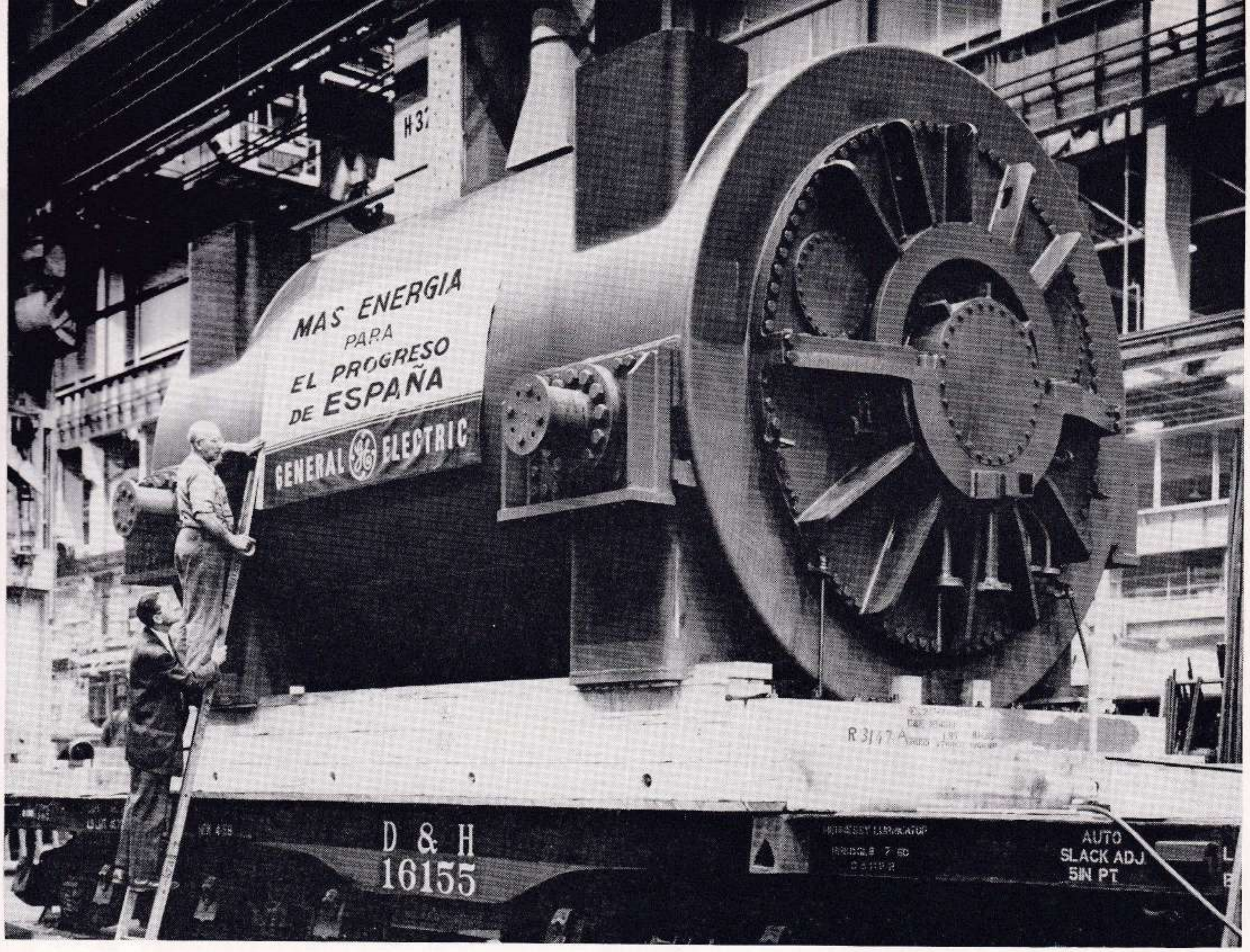
However, today capital goods purchasers are finding that they want to obtain the maximum amount of use from each piece of equipment and are willing to pay the cost of this maximum availability.

To follow the old pattern does not permit each manufacturer to offer substitutes or interlocked equipment to give maximum usage, since he is frequently providing equipment to only meet preset specifications.

But, to provide a competent manufacturer with the over-all production desires, etc., and permit him to interlock all of his known equipment into one "system," then the purchaser can obtain the maximum benefit of the manufacturer's total knowledge of his products.

Delivery of material from one main supplier can simplify construction; start-up can be equally simplified with one qualified manufacturer's crew knowing all of the integrated items of machinery; and service for the life of the machine is maintained with one all-encompassing responsibility.

While systems are becoming a necessity in today's competitive picture, there still remains the reputation, integrity, and experience of the supplier. These items become all the more important when the purchaser selects one main supplier, for such items maintain their relative stature regardless of the age of the equipment—even during the 40 year span while it may be operating.



Generator stator being prepared for shipment to Cia. Sevillana de Electricidad in Spain at General Electric plant, Schenectady, N. Y.

POWER GENERATION

"Electric power generation may be regarded as a prerequisite for modern industrialization—where electricity is in short supply, industrial development is likely to be held back... The relative position of the countries shows that there is a close relationship between consumption of electricity and income levels." (United Nations, Geneva, 1957)

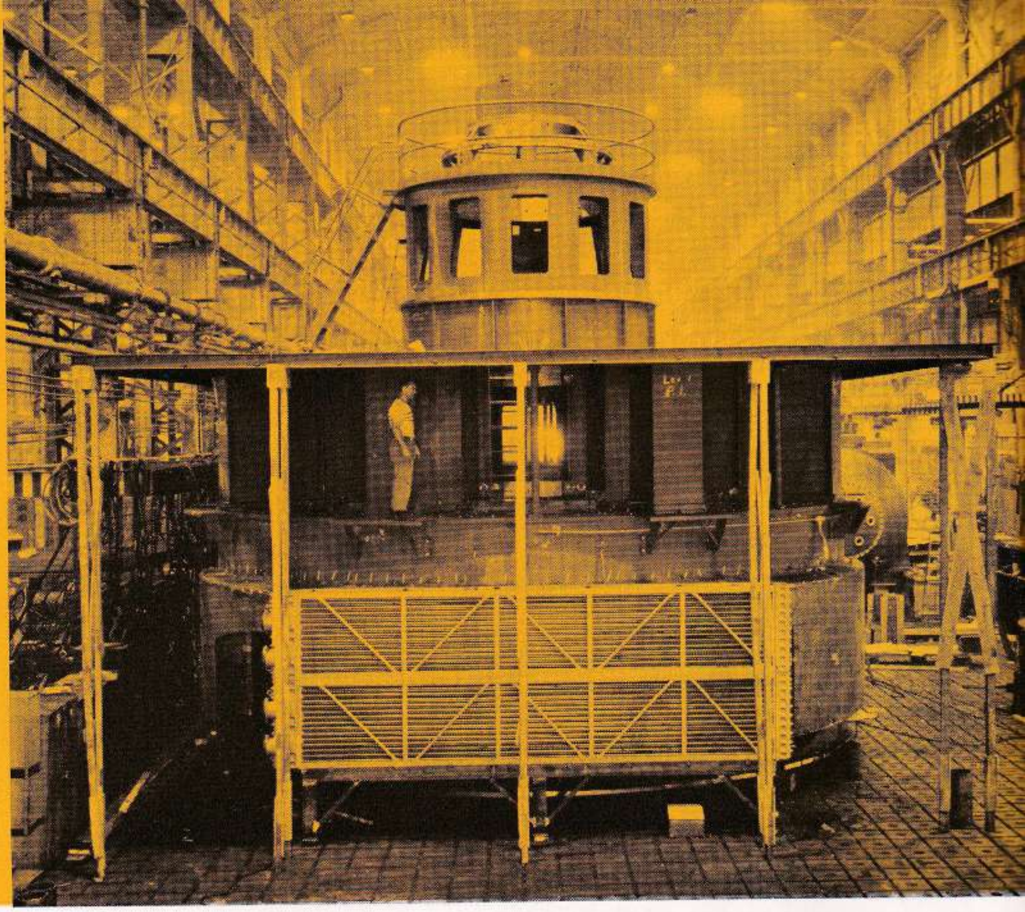
Electricity, one of the major keys to improved living conditions and increased productivity, remains in constant demand throughout the world, and in no nation has a saturation point been reached when the supply of electric power is in excess of population requirements.

According to the United Nations, most countries in the world where there is a relatively high per capita use of electricity, there will still be an annual increase in electric power production in the order of five to 20 percent over the next five years.

The UN has also stated that the growth of electric power production in some of the newer countries will be extremely large as manufacturing industries are developed, and the population begins to demand larger amounts of electricity for home consumption.

In the United States annual reviews are made of the efficiency of various thermal power generating stations including the efficiency of the steam turbine-generating units with respect to the kilowatt hours of electricity produced and the amount of fuel consumed. The General Electric Company has consistently supplied most of the turbine-generator units with the best efficiency.

The research, development, engineering techniques and experience utilized in producing these efficient powermakers for the U. S. A. are being applied in many machines now in operation, being installed or on order for overseas installations.



One of six 126,000 kilovolt ampere hydraulic-turbine driven generators for Iberduero, S.A.'s Aldeadavila dam in Spain is assembled at General Electric in Schenectady, N. Y.

Around the world there are a number of power generation developments typical of IGE activities.

INDIA: In the Damodar Valley of India some 309,000 kilowatts of electric power is now available, but studies indicate that more than 1,000,000 kilowatts will be needed by 1966.

Damodar Valley Corp. has contracted with IGE for two 140,000 kilowatt steam turbine-generator units for their new Chandrapura power station which will be one of the largest in India when it is completed.

The station will supply power for the industrial development of the Damodar Valley in the states of West Benegal and Bihar.

In the state of Gujarat, North of Bombay, an acute power shortage is expected to begin by 1962.

To help eliminate the shortage, the Gujarat Electricity Board has recently signed a letter of intent with IGE to supply four steam turbine-generator units with a total capacity of 254,000 kilowatts for a new thermal power station at Dhuvaran at the head of the Gulf of Cambay. In addition to the power generating equipment, IGE will supply associated mechanical and electrical equipment for the station, design engineering services, including the installation of the equipment to be ready to run.

The station will initially use coal for the firing of the boilers, but provisions are being made to permit the future use of oil as fuel.

The Dhuvaran power station is the first step in the development of the Cambay power project which will serve the Saurashtra and North Gujarat areas.

KOREA: The Korea Electric Power Co. will construct a 100,000 kilowatt thermal power station near the port of Pusan for which IGE has received a commitment to supply two 50,000 kilowatt steam turbine-generator units, as well as complete electrical and mechanical equipment, engineering design services, including the installation and construction of the plant to be ready to run.

SPAIN: Centrales Termicas del Norte de Espana, S. A. (TERMINOR), will construct a 70,000 kilowatt power station in northern Spain at Guardo near Bilbao. IGE has received a commitment to supply the main steam turbine-generator unit, boiler, condenser, and other associated station electrical and mechanical equipment.

MEXICO: In Mexico the Comision Federal de Electricidad (CFE) has given IGE a commitment to supply a 150,000 kilowatt steam turbine-generator unit – the largest ever ordered for service in this country.

This unit will be installed in the new Valle de Mexico power station to be constructed some 30 kilometers north of Mexico City.

Tentative plans call for this station to be expanded to contain four steam turbine-generator units, and when completed, will become the largest thermal power plant in Mexico.

Under the commitment, IGE will supply all of the electrical and mechanical equipment, design engineering services, including installation and construction of the plant to be ready to run.

The expansion plans of the Comision Federal de Electricidad is one of the prime examples of the programs now underway throughout the world to provide electricity for the ever-increasing requirements.

Recent surveys indicate that although Mexico's electric power generating capacity has substantially increased in the last 15 years, the country will have to double its generating capacity every eight years to keep up with the unfilled demands for domestic and industrial power.

IGE-supplied power generating equipment will assist Mexico in meeting these demands.

Earlier this year CFE contracted with IGE for three 75,000 kilowatt steam turbine-generator units for a new power station near Monterrey (PRODUCER GOODS EXPORTER, Vol. 2, No. 2). Also near Monterrey CFE placed in service the No. 3 turbine-generator unit at the San Jeronimo station. This unit is rated 37,500 kilowatts and was provided by IGE.

Streetlights and home appliances in the world-famous resort of Acapulco now operate on electricity from two 9,375 kilowatt steam turbine-generator units also supplied by IGE to CFE.

* * *

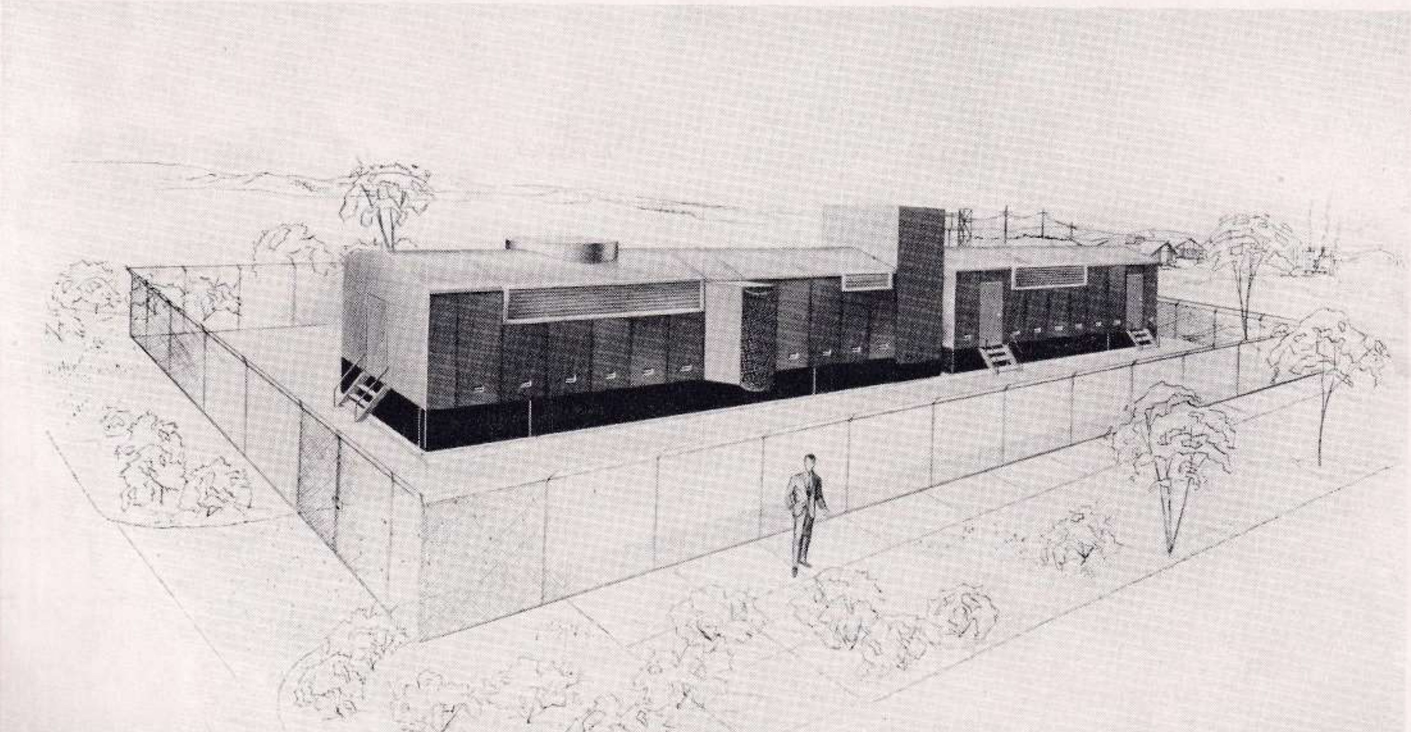
IGE has also furnished gas turbine generator power plants to various electric utilities throughout the world, and is now offering a new General Electric self-contained, factory-assembled gas turbine power package which is capable of being placed into operation within a few days after delivery at the station site.

The 10,000 kilowatt plant can be used for base load, emergency or standby service.

Highly transportable, the entire gas turbine package plant can be moved on tractor-trailers, and installed without the necessity of high cost technical labor.

The package unit is split into two main sections — the gas turbine portion weighing approximately 135,000 pounds, and the generator portion weighing some 110,800 pounds. Major port facilities throughout the world have cranes and derricks which can handle these loads.

Assembly of IGE-supplied 37,500 kilowatt steam turbine-generator unit at San Jeronimo outdoor station near Monterrey, Mexico.



Highly transportable is this new 10,000 kilowatt self-contained, pre-assembled gas turbine power plant designed by General Electric for base load, standby or emergency service.

George B. Doughman is the new Manager of the Producer Goods Export Department for the International General Electric Company Division of General Electric Co., (USA).

Mr. Doughman succeeded Charles V. Schelke who was appointed General Manager of the International General Electric Company.

Since 1955, Mr. Doughman has been Manager of IGE's User Industries Sales Section; he continues as Acting Manager of the Section.

Mr. Doughman joined General Electric in 1924 and since 1926 has been with International General Electric. He served in Mexico for more than 22 years and from 1952 to 1955 was a Director and Vice President in charge of marketing for General Electric, S.A. in Rio de Janeiro, Brazil.

MEET THE MANAGER

To the Mexican businessman, it was almost like the business activity near one of the glorietas on the Paseo de la Reforma in Mexico City.

For sitting across from him was trilingual George B. Doughman, the new Manager of Producer Goods Export Department of General Electric's International Division.

A veteran overseas marketing executive for General Electric with more than 25 years experience—22 years in Mexico—Mr. Doughman is representative of General Electric's relationship with the overseas purchaser.

The Mexican businessman, the Indian executive who entered Mr. Doughman's office only hours before, and the score of other manufacturers and directors of world-wide concerns who have visited with the new Manager, all have come away with a feeling that their problems have been thoroughly understood.

Mr. Doughman directs the activities of an organization which promotes, sells, finances and services producer goods products in markets outside the United States and Canada.

Product lines include such varied items as heavy electrical apparatus, jet engines, atomic reactors, locomotives, marine propulsion equipment and industrial control and drive equipment. Also available to world-wide customers is a broad range of application and project engineering, as well as financial, legal contract, installation and supervisory construction services.

Leaning forward on his desk for emphasis, the new Manager stressed that he and his department stand ready to meet the most extensive of overseas capital goods requirements.

"More and more we find that various manufacturers are seeking experienced, reliable suppliers who will assume overall responsibility in linking together various components in a project to insure complete production efficiency," Mr. Doughman said.

"Many years ago General Electric and IGE, the Company's overseas marketing organization, recognized this trend and developed an extensive engineering and service organization to meet these requirements," he added.

With General Electric's experience in serving a myriad of industries in the United States, the task of fulfilling the world's needs becomes much simpler.

"There's no industry that I know of where General Electric has not at one time been a leader in the development and installation of electrical equipment to fill the customers' needs," Mr. Doughman said.

And, he noted, by virtue of G. E. being the world's largest manufacturer of electrical apparatus, there are few electrical products, if any, which G. E. does not manufacture.

A good example is the metal rolling mill industry, he pointed out, where General Electric is the only firm in the world which supplies all five basic and important types of equipment for mills, such as digital process computers, x-ray and instrumentation, drive motors, controls, and heat treating furnaces.

"Basic product application knowledge, linked with experience gained through customer use of this material, provides G. E. and IGE with one of the largest reservoirs of engineering and application talent available anywhere in the world," he said.

This talent is also extremely valuable when it comes time to install the equipment at the plant site, for many times there is always that little bit of "difference" requested by customers to meet local situations. With background experience to fall back on, IGE service personnel can make correct on-the-spot changes to fill the need.

"Today we hear people talking constantly of prices—price per horsepower, or price per BTU, or price per kilowatt. But, in essence, price should be just one factor for the capital goods user when it comes to purchasing apparatus from an overseas manufacturer," he said.

"Some manufacturers have acknowledged that when they buy capital goods that it is a purchase which they will live with for many years—sometimes as long as 40 years of service," Doughman commented.

"Thus, price alone when used as the determining factor in purchase of equipment can become a life-long expensive proposition," he said.

Mr. Doughman noted that purchasers must necessarily make price a determining factor in their selection of a supplier, but must also consider the supplier's reputation to make good on his promises, the ability to supply service when required, and the ability to provide planning help when required.

"Having spent more than 20 years abroad I can remember many instances when purchasers made their entire decisions based on price alone, and still regret the choice," he said, "but one of the best stories told to me concerns a large metal processing facility in India."

"In this case the customer selected one conveyor system over another because of engineering calculations, and also because of price. However, when the conveyors started to operate, it was apparent that they were not capable of doing the job for which they were intended.

"With the monsoon season rapidly approaching, it was apparent that a new installation would be needed on a crash basis or the conveyors would be inoperative and the entire metal processing scheme would be bogged down. Then, too, wet clay was becoming mixed with the iron ore and jamming the existing conveyor facility.

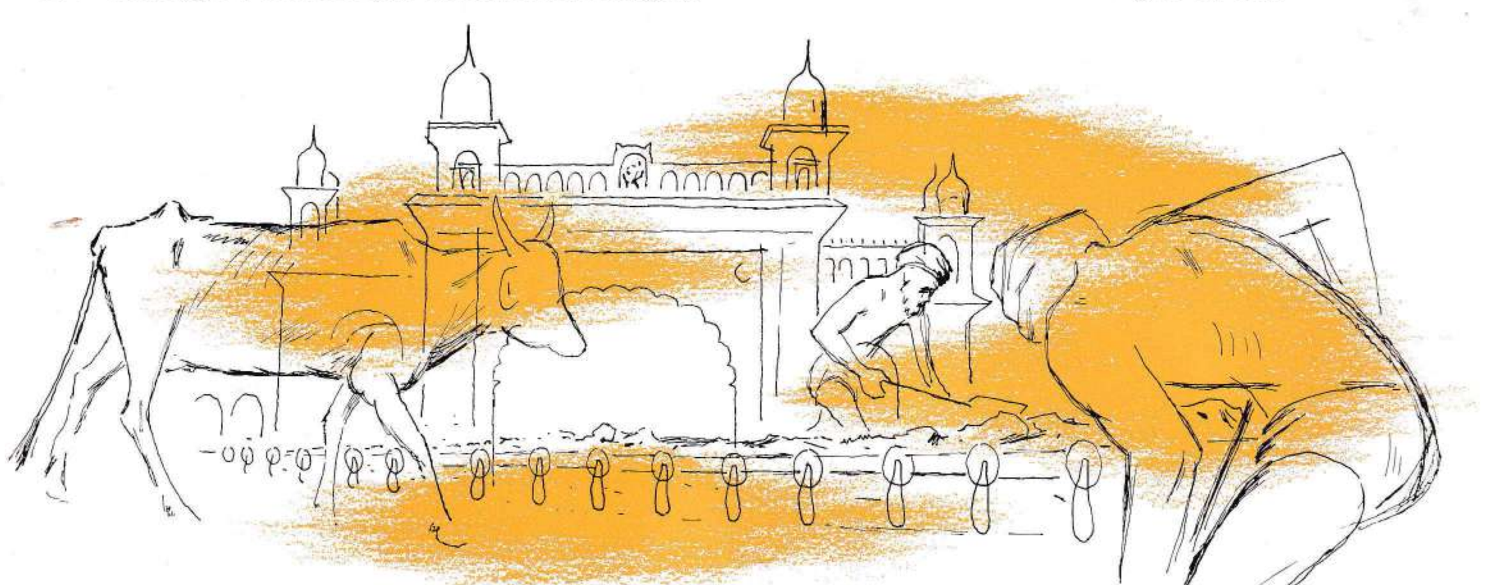
"IGE was asked to provide electric drive motors for the new conveyor on a crash basis. Within five days the 50 cycle motors were waiting at Idlewild airport ready for airplane flights to India and the installation.

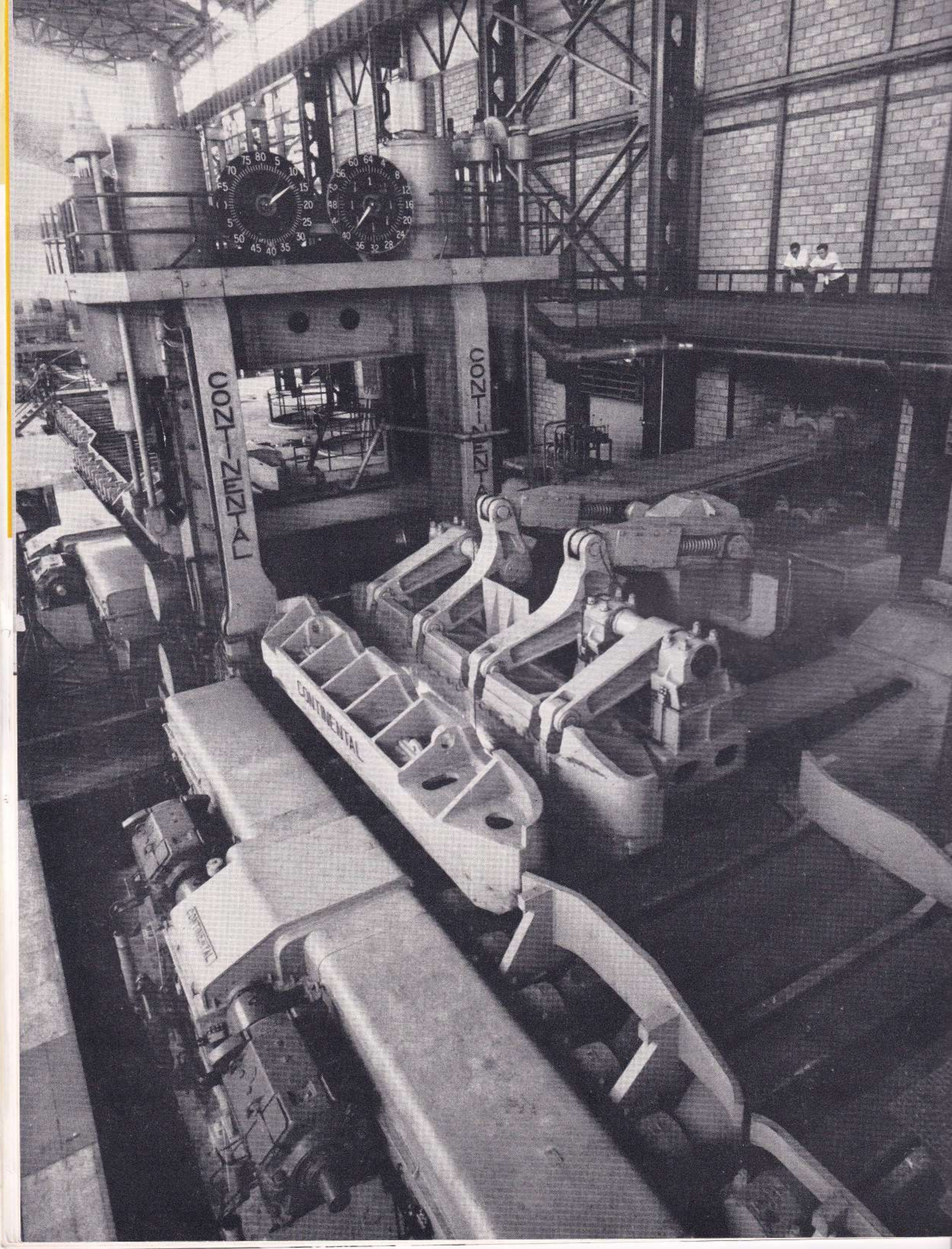
"The customer was assured that these motors were as good, if not better, than those produced during the normal manufacturing cycle, and would handle the job.

"IGE assisted in the installation, and to date the motors are operating at top efficiency."

"Production and service of this type are not common for most of the world's electrical manufacturers," he noted.

"Over forty years ago General Electric recognized the need for a separate organization to serve the world's needs, and today this staff is more qualified than ever to work with customers to meet their local challenges," he said.

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METAL ROLLING

World-wide demands for basic metals and metal products is reaching new highs every day, and from all appearances this trend gives evidence that it will continue through the present decade.

Capital goods installations basically fall into two categories: construction of new facilities and expansion of older manufacturing lines to produce materials such as bar rods, stainless steel, etc., for end-product usage; and basic reduction facilities to transform ferritic and bauxite ore into iron, steel and aluminum.

In the first situation the installations are going into the more mechanized countries like Japan, Brazil, Holland and Germany, while in most cases, the more basic facilities lend themselves to the newer countries joining the community of nations.

Metal refining and rolling technology is advancing at a rapid pace, as electronics and electrical technology provide newer methods of obtaining maximum results from the installed equipment.

Because electricity plays such a vital role in metal working —from the heating furnaces to the screw downs and rollers—many manufacturers are finding that they obtain the maximum benefits from the electrical equipment by ordering all such material from one supplier who can assist in the system design to utilize each item of apparatus to its maximum, and guaranteed performance.

IGE and General Electric have pioneered in the area of supplying complete electrical systems for the metals industry in the United States and overseas.

Today in the United States, all of the hotstrip mill gage controls currently operating are General Electric; all gauge controls being installed are General Electric; all gauge controls purchased, but one, are General Electric; and of the eight digital process control computers sold for use in the U.S. steel industry, six are General Electric.

"Where metal rolling mill systems have been extensively planned for, the owners find that they can obtain the maximum benefit from their equipment and make operations the most economical," said Eugene M. Willson, Manager-Metal Rolling Mill Sales for IGE.

"But, the big thing is to plan ahead," he said.

Willson noted that firms contemplating their new plants, or expansions to existing facilities, should start making plans at least five years in advance, and even further if possible.

"Only by making detailed and exhaustive plans which can be adaptable to utilize technical innovations as they occur, can manufacturers be sure that they are obtaining the best equipment at the most opportune time," he said.

And, how does the manufacturer find advice and counsel when formulating his plans?

"By seeking out the sources with the most experience who have assisted in the development of industry-leading installations, and who have produced equipment capable of meeting the most exacting tolerances," he said.

General Electric is today the only major manufacturer of electrical equipment for metal rolling mills with extensive experience in the development and production of the five major components for such installations: digital process computers, x-ray gauges and related instrumentation, control equipment, direct current drive apparatus, and heat treating furnaces.

Cia. Fundidora Iron and Steel of Monterrey, Mexico, is in the process of installing an IGE-supplied automatic card-programmed metal rolling mill system. This will be the first such automatic mill in Mexico.

In the Far East, one of the largest steel mill system electrification projects undertaken to date is now operating at Jamshedpur, India.

Tata Iron and Steel Co., Ltd., expanded its facilities to bring its total annual capacity to three million tons of high grade steel. General Electric through IGE supplied the electrical system for a 46-inch blooming mill, and for two sheet, bar and billet mills. G. E. also supplied Tata earlier in the last decade with motors, controls, rectifiers and switchgear for an 11-stand skelp mill—where steel is rolled for forming into pipe and tube stock; for a 96-inch plate mill, and for a 40-inch blooming mill.

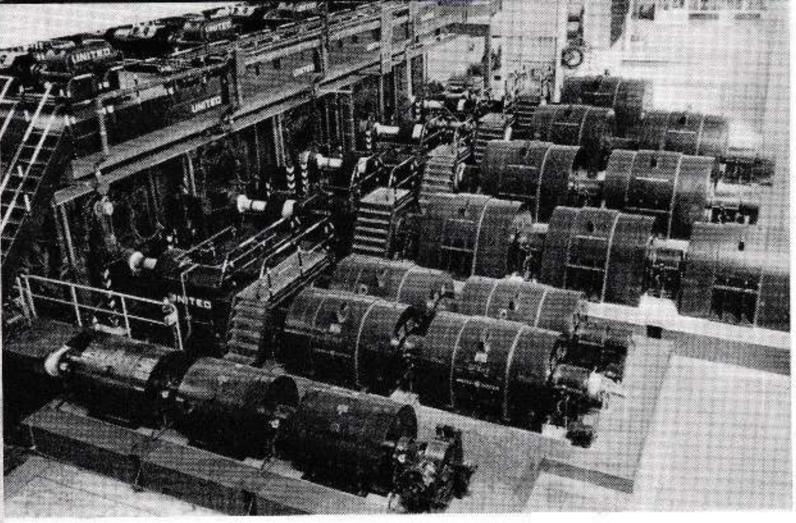
The Jamshedpur installation utilizes a General Electric supervisory and telemetering system for remote operation and checking of electrical distribution and generating equipment. While fairly standard in utility installations, the system is General Electric's largest to date in a steel mill overseas.

To meet expanding requirements for steel for the Brazil's booming automobile industry, Volta Redondo (Brazilian National Steel) is utilizing a new steel rolling mill powered with General Electric apparatus.

The entire Volta Redondo plant, near Rio de Janeiro, produces about one million tons of steel a year—making it the largest steel center in South America. It is a fully integrated plant in that operations begin with the processing of the raw ore.

Contract is signed by SOLLAC of France with IGE for Florange plant main drive motors, main drive control, x-ray gages and data logging equipment.

Blooming mill of Fundidora de Fierro y Acero in Monterrey, Mexico.



Motor room of the Rasselstein Steel Works in West Germany, Europe's fastest cold rolling mill, completely equipped with General Electric motors and controls.

Basic electrical equipment for the plant's hot strip, cold strip, and structural mills was furnished by General Electric in 1942 and installed in 1945. In the facility's first expansion, 1951 to 1955, General Electric provided additional equipment for these mills and for some of the plant's smaller mills.

The latest expansion uses G-E motors, generators and controls for three stands and for a fourth future stand—for a total of 15,500 horsepower in the main drive system of the new cold strip mill.

Maximum strip speed with the three stands is 2,610 feet per minute, or 3,160 feet per minute with the fourth stand. Maximum strip width is 48 inches.

Acindar Industria Argentina de Aceros, S.A., a major steel producer in Argentina, has ordered electrical equipment from G. E. for an extension merchant bar and rod mill located some 80 miles northwest of Buenos Aires.

This new apparatus will modernize the steel firm's existing plant facilities and increase its output of such items as reinforcing rods, angles and bars which are used in the building and road construction industries.

The extreme quality and technical competence of General Electric is evidenced in one of the largest orders received from Societe Lorraine de Laminage Continu of France which is purchasing from IGE direct current mill drives totalling some 24,000 horsepower, main drive control, x-ray gages for continuous checking and automatic correction of steel thickness, and data logging equipment to record thickness as steel is processed in the firm's new Florange plant near Thionville, France.

This new facility is expected to become one of the most modern and fastest tandem cold rolling mills on the European continent. It will be in commercial operation early in 1963 to produce high grade steel to meet world-wide demands.

In addition, IGE will supervise the erection and have overall responsibility for the electrical equipment in the entire mill.

Complete electrical control and drive equipment for a reversing cold mill addition to the Indian Aluminum Co., Ltd., installation near Calcutta, will be shipped early in 1961 by IGE.

More than 21 electric motors, the largest being a 1000 horsepower direct current mill type for the main drive, as well as the associated control equipment, is included in the order.

It will power a 750 feet per minute four-stand high reversing and finishing cold rolling mill to provide aluminum and aluminum alloy slabs or coils with maximum dimensions of 14 inches high, 44 inches wide, and 60 inches long.

To meet the mounting demands for tin-plate steel, Nippon Kokan K. K. (Japan Steel & Tube Corp.) will erect a new tinning line installation at its Mizue plant near Tokyo to begin operation early in 1962.

Direct current electrical drive equipment, as well as motor-generator sets, controls, gear motors and air-cooled silicon rectifiers were purchased from IGE.

In addition, IGE will supply a combination fuel and electric heater tower-type furnace for the continuous annealing of strip steel at a rate of 1000 feet per minute in a protective atmosphere to produce a product suitable for tin plating.

The tower type furnace is the fourth IGE has supplied Japan for its growing metals industry. One is in operation at Yawata Iron and Steel Co., another at Fuji Iron and Steel, and the third is presently being installed at Toyo Kohan Co., Ltd.

A new multi-million dollar plate mill to be erected at Monclova, Mexico by Altos Hornos de Mexico, S.A., Mexico's largest steel manufacturer, is to use electrical drive equipment supplied by IGE.

IGE will supply all the electrical equipment, including the main and auxiliary drive motors, as well as the controls.

IGE-supplied equipment in the motor and control room of Cia. Fundidora de Fierro y Acero mill, Monterrey, Mexico.

TRANSPORTATION

The first Convair Coronado 990, equipped with G-E aft-fan engines, is completed at San Diego, Calif.

On land, at sea, and in the air, General Electric products, the culmination of extensive research and experience, are in use throughout the world bringing people closer together and transporting both raw materials and finished products at the most economical costs available.

"Effective transportation services are vital to the growth of any country, whether it is one of the newest to join the community of nations, or one of the more industrially advanced," said Elbert C. Hendrix, Manager-Transportation Sales for IGE.

"To improve a nation's gross national product it must have means for moving raw materials to producing or manufacturing areas, finished products to the markets, and people to and from their work, all in coordination with other means of transportation," he said.

Since the turn of the century General Electric has been a leader in transportation progress participating in the development of the first diesel-electric locomotive in the United States in the middle 1900's.

In the last two decades General Electric has pioneered and produced the most powerful jet engines yet developed for military and civilian aircraft.

AVIATION

Next year the skies over many of the nations on four continents will be crossed by swept-wing Convair jet aircraft powered by General Electric engines.

The Convair 880 is the fastest jet airliner now in service in the United States traveling at 615 miles per hour. Powered by four CJ-805-3 pure jet engines, the Convair 880 now links 13 cities in the United States.

The newest version of this jetliner, the 880-M, will also use General Electric engines. This new aircraft is equipped with wing leading edge slats and a power boost rudder for shorter landings and takeoffs, increased fuel capacity, and a takeoff weight of 191,000 pounds. The increased fuel capacity provides the 880-M with a maximum range of 3,750 miles.

Convair 880's being assembled at plant in San Diego, Calif.

Alaska Airlines, Civil Air Transport (CAT) of Taiwan, Aviasa of Venezuela and Japan Airlines have already purchased these jet passenger aircraft.

Next year SWISSAIR, SAS and REAL (Brazil) will take delivery of Convair Coronado 990 aircraft—the world's fastest airliner with a level cruising speed of 640 miles an hour. (This aircraft was originally known as the Convair 660, but was designated the Coronado 990 to recognize its growth over the original design.

The gleaming white Coronado 990 will be easily recognizable when it begins service because of its two entirely new features—a supersonic wing and four enlarged engine pods which enclose the advanced General Electric CJ-805-23 aft fan jet engines.

The major innovation of this design is the large fan at the rear of the engine to pull by-pass air around the basic engine. This aft-fan requires large air ducts which almost surround the basic engine and which result in the engine pods being almost six feet wide at their greatest diameter.

Thus, by increasing the exhaust gas volume, the engine thrust is raised, and there is a greater economy of fuel. Thrust for each of the Convair Coronado 990 engine's is 16,100 pounds.

To enable the Coronado 990 to fly efficiently at the edge of the speed of sound, the wing had to be designed to take a continuous supersonic air flow over the curved upper surface and at the same time, prevent formation of the massive shock wave and resulting drag that have plagued older jet transport designs at high speeds.

To achieve the near sonic speeds, the Coronado 990's wing has four streamlined speed capsules on the upper surface.

Despite their size and weight, all versions of the Coronado 990 will be able to land and take off in relatively short distances—well under 5,000 feet, for example, on a 1,000 mile trip.

In addition to the G-E jet engines, the Coronado 990 and the 880 are equipped with integrated electrical systems and instrumentation developed by General Electric.

Now undergoing tests and demonstrations at General Electric's flight test center at Edwards, California, is a Caravelle VII airliner built by Sud Aviation. The plane has been re-equipped with CJ-805-23 aft-fan engines which, according to engineering estimates, will increase the speed of the Caravelle VII by three percent, and extend the range by 40 percent over most of the conventional models of the French jet. Douglas Aircraft has arranged with Sud to sell and service the Caravelle in the United States as well as many other countries. Aviation leaders attending the Paris Air Show next year will be able to see and possibly ride the G-E powered Caravelle airliner.

Between Brussels, Belgium, and Dortmund, Germany, via Eindhoven and Duisberg, Sabena Airlines has inaugurated a daily service using the turbocopter Sikorsky S-62, powered by a single General Electric CT58 engine. Another flight using the S-62 is scheduled between Brussels and Eindhoven.

These two regularly scheduled turbocopter services are the first in Europe.

The CT58 turboshaft engine powering Sabena's S-62 is the first, and to date, the only United States gas turbine certified by the Federal Aviation Agency in the U.S. for commercial helicopter service. The three commercial helicopter transportation operations in the United States—who have ordered turbocopters—have all purchased turbocopters powered by CT58 engines.

The CT58 is the commercial counterpart of the military T58 turboshaft engine which was developed for the U.S. Navy by General Electric.

DEFENSE-AVIATION

Fabrique Nationale (FN) d'Armes de Guerre of Belgium and the Bavarian Motor Works (BMW) Triebwerkbau of West Germany have purchased a considerable amount of J-79 jet engine assembly components from IGE for use in the construction of jet engines for Lockheed Starfighters being built for the Belgium, Dutch and West German air forces.

FN, as part of phase one of the program, will construct some 82 J-79 engines under a direct arrangement with General Electric. First deliveries of the jet engine assembly components is scheduled for early 1961, with the present supply contract to run until 1962.

BMW will, in its initial phase of manufacturing, build some 96 J-79 engines under a licensing agreement with General Electric via the West German government.

In a joint manufacturing effort, BMW and FN will supply each other with certain components for the jet engines. Consequently, the European-manufactured jet engines will incorporate materials manufactured in each of those countries, as well as some produced in the United States.

Two years ago the West German Republic, after considerable evaluation, selected the F-104 Starfighter with the General Electric J-79 engine as the new basic fighter for their air force. A number of planes were purchased from the U.S. Government, and some direct from Lockheed. The remainder of the planes needed by the West German air force will be assembled overseas.

Shortly after the German selection, Belgium and The Netherlands also chose the Starfighter for their respective air forces.

RAILROADS

As the new nations of the world begin economic development of their natural resources to increase their gross national product, and as other countries begin serving their interior locations more effectively, the demand for diesel-electric locomotives is expected to measurably increase over the next five years.

In the past five years, for example, more than 3,000 diesel-electric locomotives have been delivered to railways in Africa, Latin America, Asia and Oceania.

To meet this world-wide demand, and to provide the most complete line of diesel-electric locomotives available anywhere in the world with the equipment adaptable for use regardless of the track gauge, and types of breaking systems and couplers used, General Electric introduced the Universal series of locomotives.

Since this Universal model of motive traction was made available in 1956, more than 450 units, ranging in size from 640 to 1980 horsepower have been ordered, and approximately 380 Universals are now in service in Argentina, Brazil, Chile, Colombia, Mexico, South Africa and Turkey.

Recently some 179 locomotives were purchased from IGE by the Brazilian National Railways (Rede Ferroviaria Federal S.A.) for passenger, freight and switching service on six of the federally-operated railroads. Most of these units are to be delivered in 1961, and when placed in service, will augment the 500 General Electric diesel-electric locomotives of all types already in service in Brazil.

Initial operations in an $89-million development program to tap one of the world's richest deposits of manganese ore have begun in the heart of Africa with the delivery of the first Universal diesel-electric locomotives ordered by Compagnie Miniere de l'Ogooue (COMILOG), a French mining concern located in the Gabon Republic.

Three of the seven locomotives in the $1.5-million order have been delivered with the remaining four scheduled for use in mid-1961.

The manganese ore—a metallic element added to the steel to increase its toughness—lies buried in four plateaus in the hot, humid jungle near Franceville in Gabon. To extract the mineral, COMILOG will construct a 60-mile cableway to stretch from the mining area to the railhead at M'Binda in the Republic of Congo.

COMILOG will use the first three diesel-electric locomotives in the construction of a 180 mile, 42-inch gauge railroad from a siding of the Congo-Odean railroad near Dolisie to the cable-way dump site at M'Binda.

Climatic conditions will be severe since the railroad will operate in a jungle region where the temperature is almost constantly at 95 degrees Fahrenheit with close to 100 percent humidity and an average yearly rainfall of 85 inches.

The U12C locomotives destined for COMILOG will be rated 1320 horsepower with 51,000 pounds of continuous tractive effort.

One of the largest single diesel-electric locomotive orders placed in recent years was from the Union of South Africa for the complete dieselization of Southwest Africa. This contract for 115 locomotives is currently in production and will completely modernize the area and eliminate the very severe water shortage problems which occurred when steam units were used. To date some 75 units have been delivered. The locomotives are rated 1980 horsepower and are on eight axles because of the unusually light weight of the rails used in this area.

The Universal line has been extended and now includes the 2500 horsepower U25B which marks a significant step forward in railroad progress. The objective of the new design is to reduce dead weight to a minimum, obtain high horsepower with a minimum of machinery, reduce fuel consumption and maintenance costs, and to provide the world's railroads with a new level of motive power that will move freight trains at the higher speeds demanded in today's competitive transportation picture.

MARINE

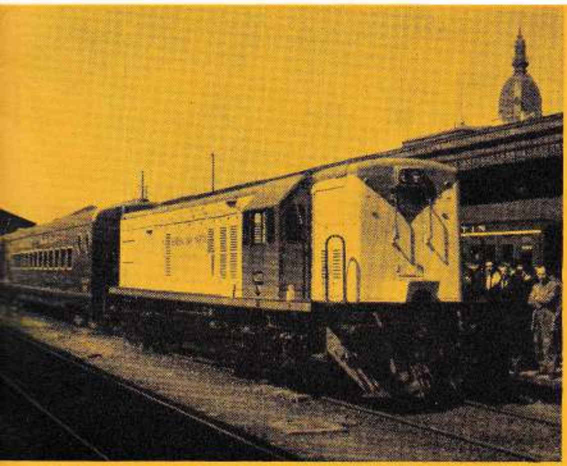
Biorn Biornstad Co., independent Norwegian shipping firm, has announced plans to construct a 38,000 deadweight ton tanker using an IGE-supplied complete package engine room.

Under the recent contract, IGE will supply all of the engine room propulsion machinery, including the steam turbines, reduction gear sets, electric-power producing generator sets, boilers, condensers, etc.

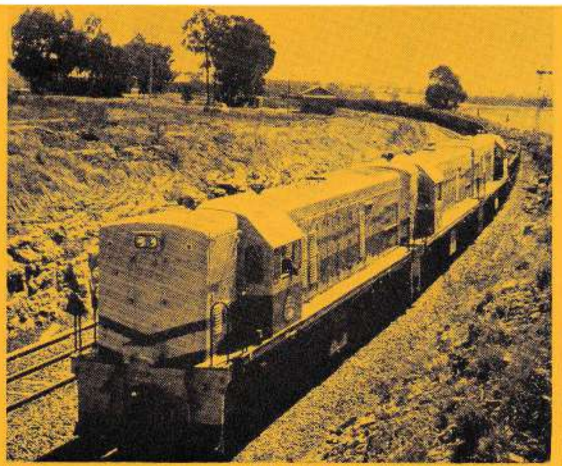
Total tonnage to date on which commitments have been received for IGE packaged engine room plants since the concept was first introduced to shipping circles some three years ago is now more than 1,000,000 tons.

The T. T. *Caroline Maersk* (PRODUCER GOODS EXPORTER Vol. 2, No. 2) is currently in service transporting Persian Gulf oil to Europe, and it is reported that the *Caroline Maersk* is bettering guaranteed fuel rates with a crew whose previous experience was confined mostly to diesel propelled vessels.

"Because all of the engine room equipment is integrally designed into one system to obtain the maximum operating efficiency from each piece of apparatus, the packaged engine room concept provides ship operators with greater economies," said J. P. Jurga, Manager-Marine Sales for IGE.



Universal-line General Electric diesel-electric locomotive in service on General San Martin Railway in Argentina.



South African Railways coal train pulled by three General Electric Universal diesel-electric locomotives.

The 2500 horsepower U25B, newest addition to General Electric's line of Universal diesel-electric locomotives.

ATOMIC POWER

West Germany — near Frankfurt am Main at Kahl — has joined the growing list of world-wide geographic locations where nuclear energy is being used for peaceful applications for the benefit of mankind.

In mid-November, a 15,000 kilowatt electrical capacity boiling water reactor, designed by the General Electric Company and using enriched uranium fuel, sustained its first nuclear chain reaction at the Kahl Nuclear Power Plant. Initially, this plant will be operated up to power levels of 1,000 kilowatts, as permitted by its first operating license granted by the Bavarian Ministry of State for Economy and Transport in behalf of the Federal Republic of Germany.

For several months the boiling water reactor (BWR), will be operated at low power levels to permit comprehensive tests of plant operations. After these tests, the reactor will be brought to full rated power, at a rate dependent upon test results, as well as upon the conditions of the license received from the German government.

The Kahl Nuclear Power Plant is owned by Rheinisch-Westfaelisches Elektrizitatswerk (RWE) and Bayenwerk, two large West German utility companies. The plant operator is Versuchsatomkrattwerke of Kahl, a totally owned subsidiary of RWE and Bayenwerk.

International General Electric Operations S. A. (Geneva), a General Electric subsidiary, is furnishing the G-E equipment and services to AEG Frankfurt, the prime contractor for the plant.

Members of the operating staff for the Kahl reactor were trained by General Electric at its Atomic Power Equipment Department headquarters in San Jose, California. General Electric also supplied the nuclear fuel which contains 6.6 tons of slightly enriched uranium dioxide. A fuel load consists of 88 fuel element assemblies. Also being supplied are 12 spare fuel assemblies.

According to RWE officials, the Kahl installation will serve a dual purpose: to generate electrical energy for use by West Germans and to help stimulate additional nuclear projects through participation of German industry in the manufacture of many nuclear components.

Thus, the Kahl Nuclear Power Plant is another pacemaking installation which is benefiting from General Electric research and development in the peaceful applications of atomic energy.

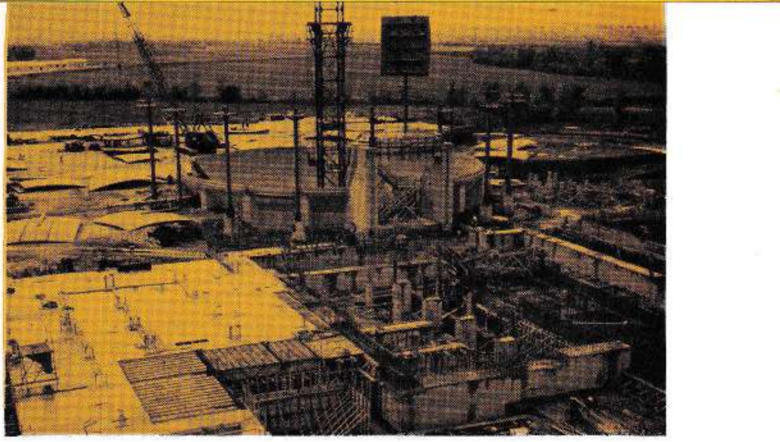
Cost-wise, the energy produced by the BWR-type of nuclear power plant is now becoming economically competitive with conventional power plants in many parts of the world.

"Based upon cost studies conducted on Commonwealth Edison Company's 180,000-kilowatt Dresden Nuclear Power Station, near Chicago, Illinois, it is our conclusion that, in many parts of the world, the cost per kilowatt hour of energy from nuclear power generating facilities is equivalent to that of conventional plants burning fossil fuels," said Robert J. King, Manager-Atomic Products Sales for International General Electric.

"Commonwealth Edison officials noted at the October, 1960, dedication of the Dresden Station that the cost per kilowatt hour of electricity produced there is expected to be comparable

Republic of the Philippines research reactor operator trained by General Electric at San Jose, Calif.

Construction underway at Garigliano Nuclear Power Plant of SENN near Naples. First steel plate for reactor sphere is being moved into position for lowering and being locked into place.



with that of the conventional steam plants of their system," he reported.

"Based upon the continuation of nuclear research and improvements introduced by the experience of design, construction and operation by General Electric and others, many countries planning new power stations to meet the rapidly increasing demands of industries and populations will be able to justify nuclear power installations," he said.

ITALY: Near Naples, Italy, the Garigliano Nuclear Power Station of Societa Elettronucleare Nazionale (SENN), a group of private and government-controlled utilities, is "on schedule".

International General Electric Operations S. A. (Geneva), a subsidiary of General Electric, is building the 150,000 kilowatt dual-cycle boiling water reactor plant which is scheduled to be providing electricity to southern Italy in late 1963. It will use enriched uranium fuel. Design work for the entire plant is more than 70 per cent complete, and construction is 15 per cent complete.

USA: The atomic power plant reactor design concept being developed in the United States by General Electric for the Consumers Power Company for its Big Rock Station in Michigan is expected to be of considerable interest throughout the world. The 50,000-kilowatt (electrical) BWR-type nuclear power reactor using enriched uranium fuel will evaluate the potentiality for high power density fuels and high specific power.

Main area of development will center around the reactor core and fuel design. The goal: to demonstrate the feasibility of higher heat output in relation to the size of the reactor core, longer fuel life, and lower fuel fabrication costs.

A further insight into the larger nuclear power plants of the future will originate at Humboldt Bay Station in California, where General Electric will provide the Pacific Gas & Electric Co. with a 50,000-kilowatt nuclear steam supply system that will be the largest single-cycle, natural circulation BWR reactor designed at this time.

JAPAN: Japan's Atomic Energy Research Institute (JAERI) contracted in August, 1960, for a complete plant with a boiling water reactor as pioneered and developed by General Electric. This plant, identified as JPDR, will be a 12,500-kilowatt (electrical) power demonstration reactor, to be located near Tokyo.

General Electric Japan Ltd. is the prime contractor for the plant; General Electric will design and supply the nuclear part of the plant, including the enriched-uranium fuel.

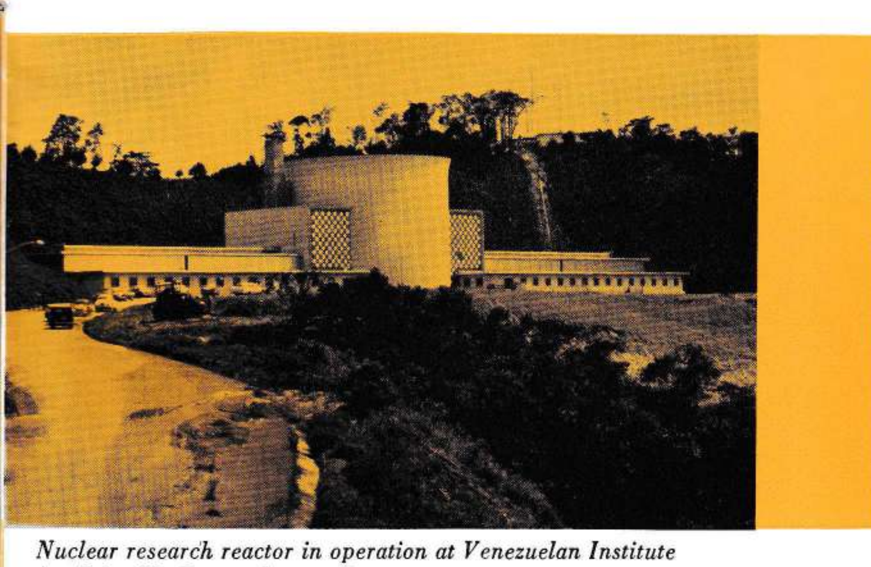
Located in a nuclear development center which includes several research reactors, the plant will be used for nuclear research and development as well as the production of electricity.

This reactor is scheduled to achieve its initial chain reaction early in 1963, and it is expected that it will be the first nuclear power station to go into operation in the Far East.

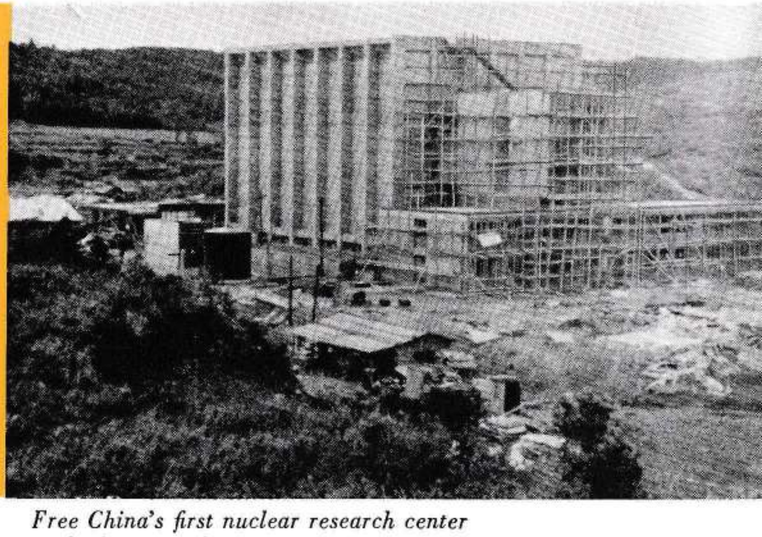
RESEARCH REACTORS: Elsewhere in the world, two additional countries will soon begin operating General Electric reactors. They are:

- Republic of the Philippines, where, during 1962, a research reactor will go critical at the Philippines Atomic Energy Commission installation at the University of the Philippines near Manila. The open pool reactor is rated at 1,000 kilowatts (thermal), but is designed for later expansion to 3,000 kilowatts (thermal).
- Free China on the island of Taiwan where a nuclear research reactor is entering the final stages of installation at National Tsing-Hau University near Taipei. The open pool reactor, rated at 1,000 kilowatts (thermal) will be used for basic research, as well as in such fields as biology, medicine, and agriculture, as well as for the training of students.

Near Madrid, Spain, and Caracas, Venezuela, General Electric open pool reactors, rated at 3,000 kilowatts (thermal) are already being utilized for medical and biological research, as well as for basic agriculture and scientific investigation.



Nuclear research reactor in operation at Venezuelan Institute for Scientific Research near Caracas.



Free China's first nuclear research center in final stages of construction.

PLAN A SYSTEMS APPROACH NOW

By John C. Garrett
Industrial Electronics Div.
Division Planning Operation
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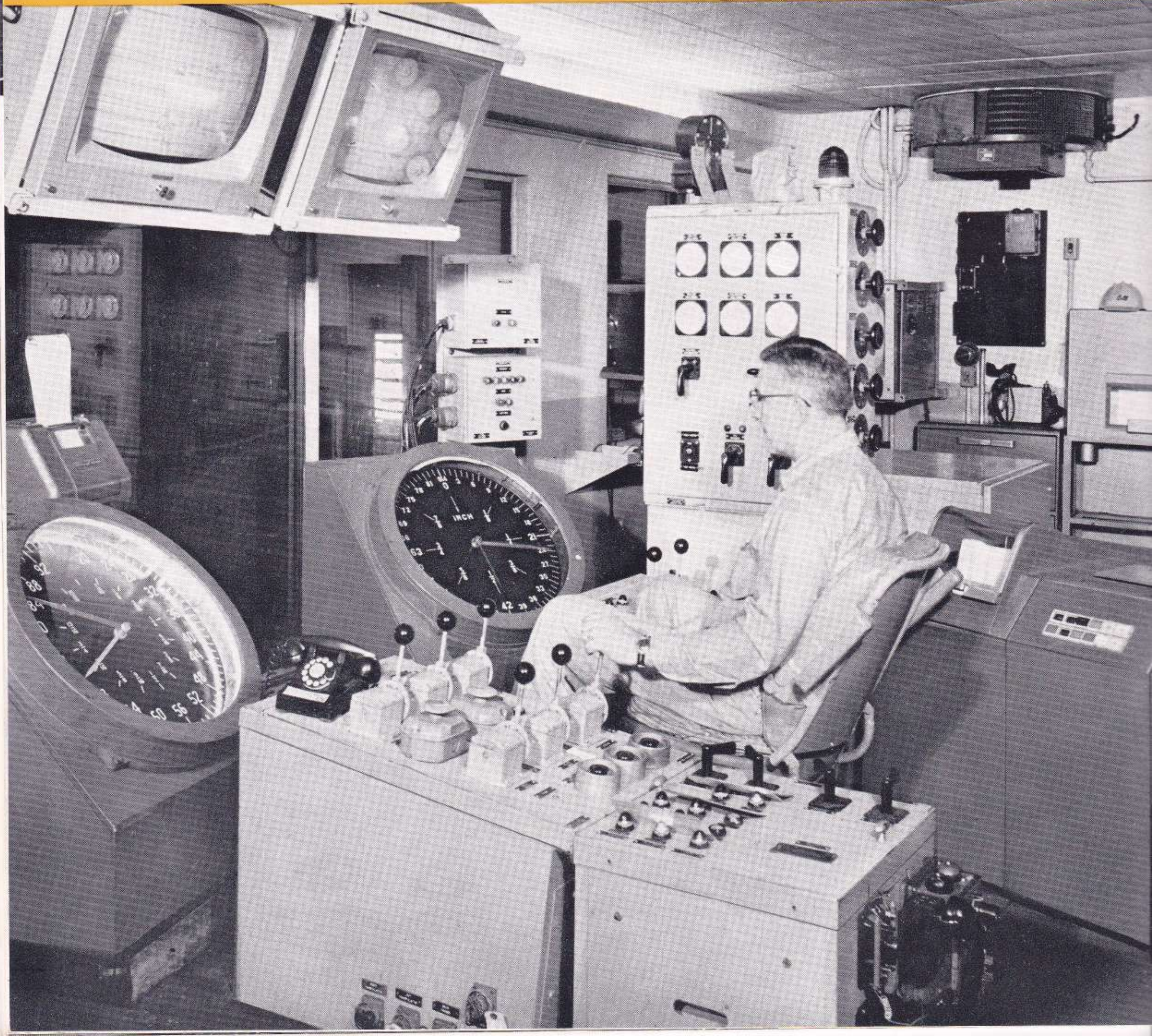


Portions of this article originally appeared in Industrial Electronics, September-October 1960

Application of industrial electronics is vital for profit and economic survival. Outlined here are the reasons why management should consider use of electronics now; the benefits that will be received and the initial planning steps to be taken, and a checklist of steps to be considered in planning for and integrating electronics into each business function.

Increasing application of electronic equipment to aid industrial progress has come about, in many cases, because it offered the only means for utilization of new processes and techniques.

Electronic information systems combined with energy conversion systems form the basic two parts of a complete industrial package. Without the products provided by industrial electronic technology, information systems and the future growth of automated systems would be virtually stopped.

Management must accept the fact that application of industrial electronics is a vital tool for profit and economic survival. Such applications will influence the lives of everyone and will be a major factor in deciding whether the business can remain competitive and grow against competitors. It is no longer a question of whether or not to apply electronics industrially but rather it is how far to go and how fast to proceed.

The application of electronic equipment to any facility will entail very careful and detailed planning and study long before purchases of equipment are made. Perhaps the first question is, "Why use electronics?"

1. To build a consistently high-quality product at the lowest possible total cost.
2. To obtain cost leadership with respect to competition. Cost leadership can be obtained through innovation which can also give product leadership. The ultimate in cost leadership is achieved by coupling electronic automation with an inherently lower cost product.
3. To improve the profits of business and to prevent the profit squeeze by offsetting rising material and labor costs.
4. To provide better service to customers—faster delivery, and availability of product can be provided through improved forecasting and inventory control. It has been said that the ultimate would be reached when a product or service is manufactured and delivered to the user instantly upon demand. In this system, the purchase is recorded, the bill mailed, payment received and recorded, product cost figured, and the factory owner's profits deposited to his account.

   Better service means a more advantageous competititive position and may be the best way to combat competition—by educating customers to expect service that only your automated system can provide.

   The system can also give better inventory control, less inventory, automatic recording, automatic billing and improved management information.
5. To increase working capital through better inventory control. With a well organized and implemented program, inventories can be reduced thus freeing working capital for other jobs.
6. To improve the quality of your product. Closer control of factory processes can improve quality, increase yield and reduce costs. It provides a superior product that sets new standards of excellence in the industry. The headlines say improved quality. The side benefits can be lower cost, fewer complaints and product leadership to name a few.
7. To properly utilize new processes and techniques made possible by the application of electronic equipment.

BENEFITS DERIVED

There are many benefits, usually peculiar to each business, that can be attained through use of a well thought-out and inspired program. Some of these benefits are:

1. Better forecasting using computer techniques with resultant closer coupling between factory, warehouse and customer. The degree of sophistication best suited for a business may only require simple historical trend reports, or it may require accurate day-to-day reporting of orders with automatic warehousing, inventory control and stock replenishment.
2. Better control of the resources of business including inventory and time and the opportunity of automating repetitive tasks.

Closed-circuit television is playing a key role in the progressive automation of many industries.

The cost of time in the day-to-day operation of business can well be the most important cost element—either as an asset or as a liability.

3. Better management information when you want it—in the form you want it so that you can more easily manage your business. It provides an opportunity to manage by exception since your reporting system can be instructed to report only when a "beyond forecast" or "out of control" signal is generated.

   It should be stated that the system can also generate more information than you can possibly use or assimilate if you design it to be information happy.
4. The opportunity for product redesign so that it can be manufactured more automatically and at lower cost. It may be uneconomical to attempt to automate manufacturing of a present design. However, a redesign of the product to give better performance may mean both lower inherent manufacturing cost plus the opportunity to further reduce costs through electronic automation.

   Frequently, parts are eliminated, combined or simplified in the electronic automation process resulting in lower costs, less inventory and fewer parts to order, inspect and stock.
5. Greater output from your factory or office process per unit material, labor and energy input.

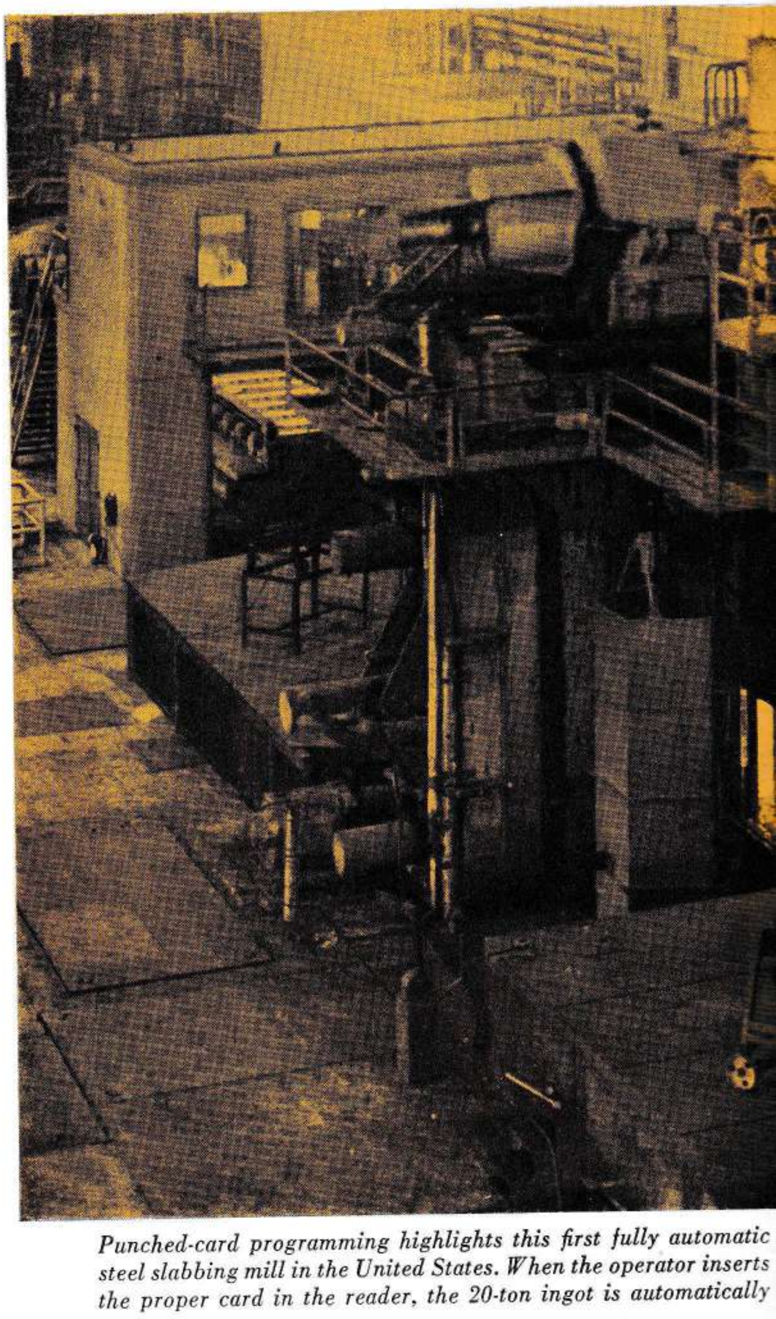
   The petrochemical industry is replete with examples of how a study of the process, by simulated or other means, allowed an increase of the yield by better control of the process variables. Comparable progress is now evident in older industries such as steel and cement.

   As efficient as is the generation of electrical energy, further progress towards application of electronics is being made through use of computer-controlled generating systems. Automatic dispatch systems further provide for the near ultimate in econmic allocation of power to the use centers at lowest incremental costs.
6. Expansion and upgrading of both direct and indirect labor. Applications of industrial electronics, all good in themselves, sometimes produce upsetting effects when installed so far as individual groups of workers are concerned. In travel, for example, electronics has provided more rewarding jobs than did the shoeing and grooming of horses. Furthermore, as we move into integrated electronic automation, with the elimination of dull, repetitive jobs, it is possible to upgrade most employees and put them onto challenging tasks which really benefit the business.

Assuming you now want to take a serious look at the possibilities for application of electronics in your business, what are some of the planning steps you should take?

1. Organize for it! While automation may be everyone's job—usually this job is too big to be accomplished effectively without an approach and an organization that is geared solely to look and to think ahead. The day-to-day requirements of any modern business provide too many interruptions to this all important work of forward planning.
2. Appoint responsible, capable, and creative people. The type of system you end up with will be about in direct ratio to the inputs in the form of the capabilities you assign. It is probably true that you should never try to electronically automate the manufacturing of your product in the same way you are now doing it. Do it for tomorrow.
3. Establish a long-range plan. This plan should list the specific projects to be studied or undertaken, their priority and a tentative time schedule. Don't be inflexible, however!

   A program should be based on the long-range plans for the business including changes in customer requirements, new technological developments and anticipated competitive action.
4. Organize on a multifunction basis. Electronic automation will affect each of the functions of your business. To provide for inherent integration, organize for it.
5. Take advantage of educational opportunities through educational, consulting and professional organizations. Don't hesitate to enroll selected people from your organization in appropriate courses. Rub shoulders with the experts.



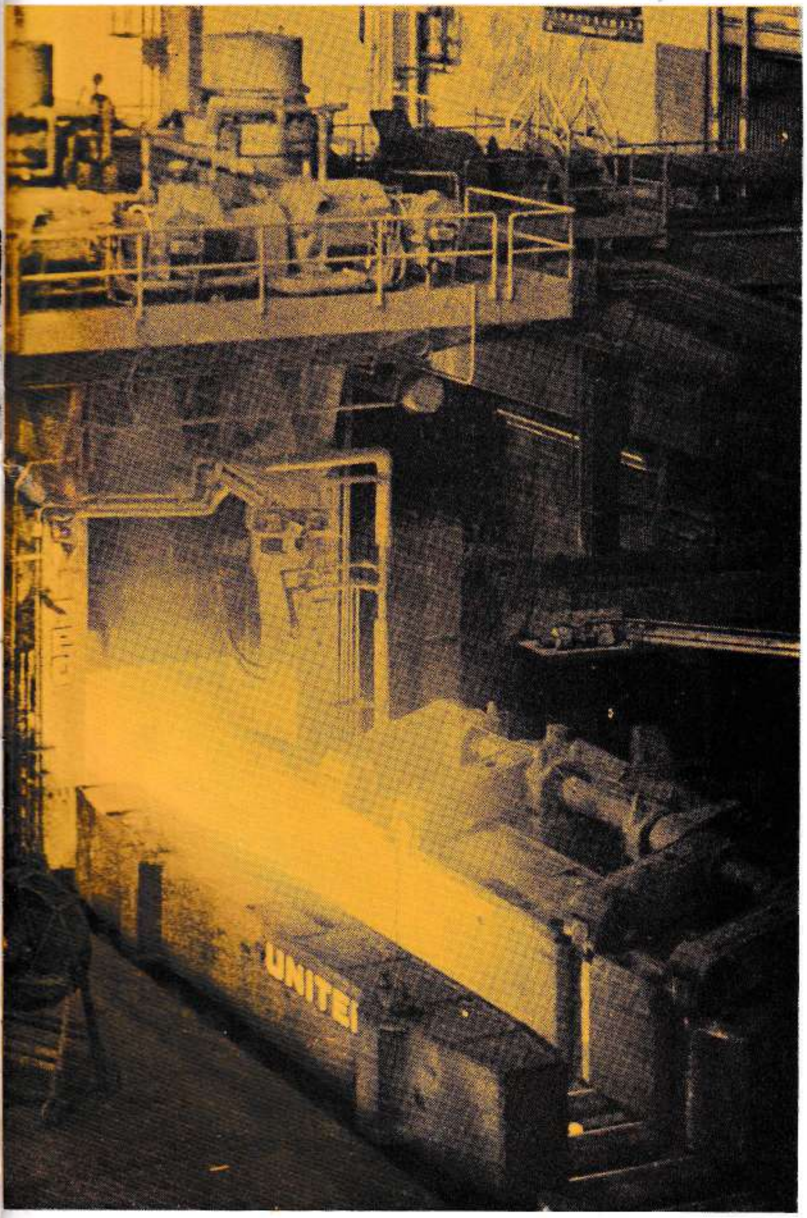
Punched-card programming highlights this first fully automatic steel slabbing mill in the United States. When the operator inserts the proper card in the reader, the 20-ton ingot is automatically

6. Seek advice and counsel. It is not necessary to reinvent the wheel. Industrial electronics resources can be found in many places.
7. Provide active managerial support. The success of any program depends upon active participation of management.

The main consideration to keep in mind is that the industrial-electronics plan is an investment in your company's future. Unless you have an active and inspired program in place in your business, your present methods of operation are probably obsolete.

It will take approximately two years to study, recommend and to put into being a fairly comprehensive program. Planning must start now—it is later than you think; but the technology and skills known today with regard to electronic automation equipment are such that a new generation of plans can be formulated and established.

It is now necessary to examine your business to decide on the specific objectives for your automation program. These objectives may vary by function within your business and, therefore, each function should contribute to their establishment. For example, Marketing may want shorter delivery time; Manufacturing, reduction in losses and reduction in "in process" inventory; and Finance, a profit statement on the business the day after the business month officially closes. In undertaking to develop objectives for the whole business system in general, it is important to note that the establishment of objectives for one function makes possible the forming of objectives for the next. This relationship between functions must be emphasized at all times during the early phase of planning to assure a well-integrated total program.



rolled, edged, flipped-over and re-rolled and edged to exact dimensions. Increased yield, optimum mill use result. The mill is operated by the INLAND STEEL Company.

With the objectives established, plans can begin for integrating all functions of the business to provide a complete program appropriate for your business. The goal of this program will be to accomplish automation of all functions starting with the customer order and ending with shipment of the finished product—extending even to service of the product after installation.

Before continuing, it is important to arrive at a common understanding of the word "automation" as it is being used today.

A good working definition is, "continuous automatic production." In this sense, the word "continuous" means uninterrupted by the actions of people; "automatic" means self-regulating—depending only upon the predetermined decisions of people; and "production" means the processing of information and materials in making goods and services available for market.

The job for automation can now be defined as: "the automatically controlled, rapid processing of information and materials to create, distribute and service quality products and to make more effective use of human participation." The definition turns out to be a desirable characteristic of your entire business system.

Automation applies to information data as much as it applies to materials—to Marketing as much as to Manufacturing—to Engineering as much as to Accounting. Over-all planning and integration between all functions is involved and it is the purpose of this article to explore the necessary steps to be taken.

Certain principles apply to all functions. Some of these are:

1. Do as much work as possible in one operation. It may be necessary to divide the total work among a number of operations, but opportunities for simplifying and consolidating jobs should be constantly investigated.
2. Automate repetitive operations, especially those where human decisions affect the quality of the output or introduce errors. Make one operation or input serve as many functions as possible.
3. Continue useful work only. As elementary as this sounds, there are many instances where the work being done is really not needed at all.
4. Develop manufacturing methods which are compatible with automation. Consider altering methods completely to conform to automation principles. Automate for tomorrow—not for today.
5. Recognize that long-time cycles are necessary in working toward the future, particularly in projects involving heavy investment.

6. Provide adequate funds for planning and developing your system. These costs may average about 25 per cent of equipment costs and should be so budgeted.
7. Develop a common language or communication means that can be used throughout all functions in the system.

In more detail, these steps are:

1. Analyze all aspects of direct and indirect labor.
   a. Determine number of employees in each function and sub-function.
   b. Examine the stated responsibilities of positions or job descriptions.
   c. Examine the output of positions and determine what compromises have been made due to human factors. Find out how individuals really spend their time.
   d. Ask the questions, "why is this work being done at all?" or "how might it be simplified?"
   e. Analyze the expense of each position or work station.
   f. Catalog actual working time vs. idle time with respect to people and to material.
2. Examine the work area of your plant, warehouse or office.
   a. Determine the effectiveness and continuity of work flow and spot the bottlenecks.
   b. Observe if there is enough room for operations to be performed efficiently.
   c. Determine if productivity is adversely affected by working conditions, plant layout, or other easily corrected situations.
3. Examine the flow of information and material.
   a. What is the flow pattern? Is it possible to study the origin and destination of each form or piece of paper or is it easier to make a clean start and design a new system to supersede the old?

MARKETING OBJECTIVES

Determine what you want the system to do to best satisfy your customer wants and to improve your competitive position. As examples—improved delivery time—improved quality levels—ability to determine immediately the availability of finished goods.

Planning steps to be taken:

1. Provide in cooperation with Engineering, Manufacturing and Finance, a product identification means that can be used throughout the entire system and by your customers.
2. Determine what type of information is required from Marketing to make the system successful. As an example, market forecasting will probably be required on dollar orders, unit volume, and the timing as to when the customer will want your product. However, remember that forecasting is not an exact science and that the system design should allow for reasonable deviations.
3. Study the methods and logic of your distribution system and determine areas for simplification. Look for opportunities to apply techniques in this study process. Areas for emphasis include your field warehousing, pricing methods, and as already mentioned, forecasting.

ENGINEERING OBJECTIVES

1. Provide product designs which will allow manufacturing of the product by more automatic methods or by more economical building block approaches.
2. Provide design and product manufacturing information in machine-sensible form suitable for direct processing into the system.

Planning steps to be taken:

1. Design products with ease of manufacturing in mind—to over simplify, design it so that it will fall together. The design of a product dictates to a large extent its manufacturing cost, production time cycle and to some extent quality. For this reason, it is vital that products be designed with ease of manufacturing in mind.
2. Obtain the guidance of manufacturing people who can contribute their production, tooling and process know-how into the product so that the product can be produced at optimum total manufacturing cost. It may be impractical or uneconomical to attempt to automate your present product design.
3. Look for the "building block" or simplified sub-assembly approach on complicated products or systems.
4. Investigate design logic to determine if computer techniques can be used to accomplish product design.

MANUFACTURING OBJECTIVES

The general objectives of the manufacturing function, in addition to the whole job of production, are to reduce inventory, improve quality and reduce costs. In planning for automation, another important objective must be added namely, providing for flexibility.

Flexibility must be the key factor in a sound, integrated business system. No matter whether a manual or automatic method is in operation on a given process, this method must be integrated with the total system as it is finally designed.

Planning steps to be taken:

1. Analyze each process of the factory operation. Many individual procesing systems and mechanized operations now exist. These systems take materials and planning instructions or engineering drawings as inputs and produce finished parts or products as outputs. These systems often constitute succesful "Islands of Automation." In this analysis, three considerations must be applied:
   a. Volume—determine maximum output to be expected now and in the future.
   b. Mix—determine the variety of work to be performed.
   c. Product Trend—determine the possibilities of product construction in the future based on current or likely trends.
2. Determine the most economical automated approach as compared to the best manual method. Your results may show that for the present, a manual approach is the best one to accomplish the work.

Cement-making will soon be computer-controlled as a result of investigations of the process recently completed by G-E engineers. The key sensor will be General Electric's new X-Ray Emission Gage, providing continuous analysis at key points. Exact predictability of end product is a major benefit.

3. Begin the training of personnel in the operation and maintenance of automated equipment and systems. New methods will be required and proper advance training will increase the chances for successful implementation of automated processes.

FINANCE

The financial function of most businesses is primarily concerned with information handling and information flow.

In an integrated system, the financial function will not normally begin or conclude any process in the system. Inputs to the financial operation will be generated by the other functions for processing by finance and for specific financial action. The resulting outputs will be directed to the other functions for action.

The objective is to process information rapidly, accurately and at low cost with outputs as needed and in the form useful for profitable operation of the enterprise.

Planning steps to be taken:

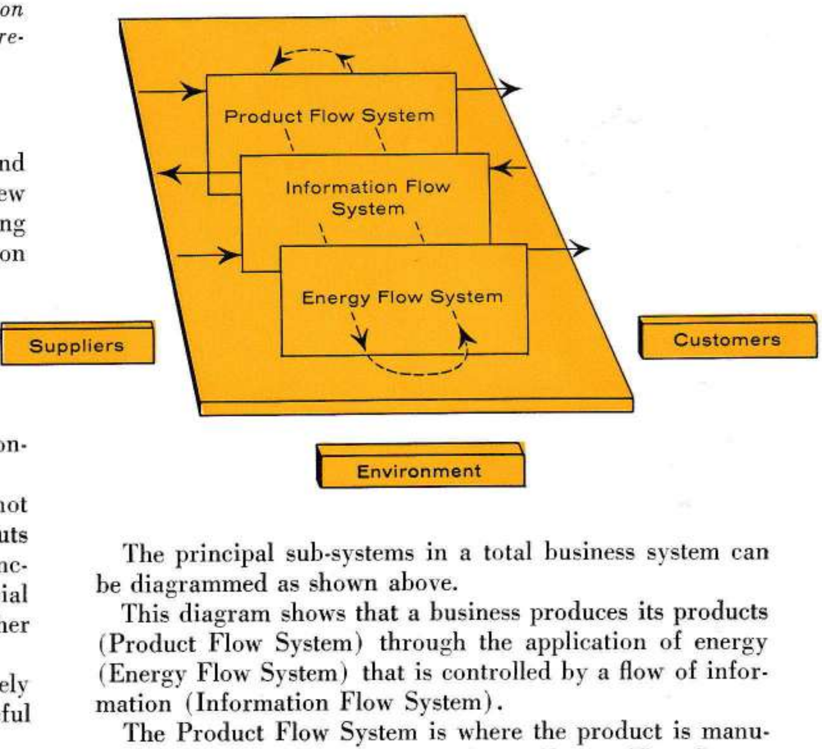
1. Provide the means for one document to serve many purposes. For example, the customer order form can be designed for use throughout the business system.
2. Provide for auditing the information flow system, even bringing about changes in other functions where necessary, in order to maintain consistency in routines and procedures.

The task of planning is a matter of fitting all of the specific processes in each function into the integrated system. Each function must contribute to the work of others in order to make the entire system successful.

As you begin to analyze your business, through the process of determining the specific objectives and planning steps necessary for your individual business system, it will become apparent that the duties and responsibilities for planning in each function within an integrated system are essentially the same.

In conclusion a thought about planning which was mentioned earlier should be reemphasized. The application of electronic equipment to any facility will entail very careful and detailed planning long before purchases of hardware are made. Nevertheless, never hesitate to call on suppliers or experts for advice and counsel. They have devoted time and effort to developing systems and equipment to meet a great variety of circumstances and they can save you valuable time.

With the planning accomplished, the next logical step is to briefly examine the equipment available which will make possible an integrated automation system for your business. It must be pointed out that this article by no means covers all the available equipment. However, it should give you an idea of the kinds of equipment necessary.



The principal sub-systems in a total business system can be diagrammed as shown above.

This diagram shows that a business produces its products (Product Flow System) through the application of energy (Energy Flow System) that is controlled by a flow of information (Information Flow System).

The Product Flow System is where the product is manufactured, processed or transported. The Energy Flow System provides the human, mechanical, electrical or heat energy to operate the Product Flow System.

The Information Flow System makes possible the application of energy (Energy Flow System) to the manufacturing process or Product Flow System. The Information Flow System contains the basic automation elements of sensing, converting, computing, communicating, controlling and displaying. The expanding technology in electronics and the development of components for the Information Flow System have made it possible to automate all phases of a business. This is automation starting with the customer order or inquiry through final billing of the customer and payment of vendors and employees. It includes the direct placing of this order at the factory or warehouse; computer scheduling of the factory with resultant inventory control and material reordering; the automatic manufacturing, testing and inspecting of the product; and service of the product after it is sold.

A discussion of the equipment available to perform each of the basic functions of sensing, converting, computing, communicating, controlling and displaying, will provide an adequate picture of the components needed for automation systems.

SENSING

A sensor is a product used to measure a physical, electrical or chemical quantity and to provide a display of that quantity, or to provide a signal for use in an information handling system.

The variations in types and kinds of sensors or primary detectors and the quantities they sense can be practically endless. However, a list of primary sensors would include the following:

1. Voltage
2. Current
3. Frequency
4. Resistance
5. Capacitance
6. Magnetic Field—Flux
7. Permeability
8. Time
9. Velocity-Speed
10. Light-Color
11. Temperature
12. Presure-Vacuum
13. Flow
14. Force-Strain-Stress
15. Mass
16. Humidity
17. Viscosity
18. Length
19. Electrostatic Charge—Field
20. Electromagnetic Radiation
21. Dielectric Constant
22. Acceleration
23. Neutron-Flux
24. Density
25. Inductance

CONTROLLING

CONVERTING

The function of converters is to change information from one type or form to another in order to facilitate the transmission, storage display or manipulation of information without altering its absolute value.

The types of converters can be as follows:

1. Those that convert information from analog to digital form, digital to analog, or one analog value to another such as voltage converted to shaft position.
2. Those that convert information from one code to another code such as ten digit or decimal code to a binary code.
3. Those that convert information from one storage medium to another, e.g., manuscript to punched magnetic tape or punched card to tape or memory unit.
4. Those that amplify, transform, rectify or invert electrical signals.
5. Those that convert information into a form for easy transmission such as multiplexers, modulators and carriers.

COMPUTING

A computer is a device capable of accepting information, processing this information through a sequence of arithmetic and logical operations in accordance with instruction, and of providing results of this processing in an acceptable information form.

The functions that computers perform include: store information, sort-compare, translate-code-decode, simulate, calculate, retrieve, program, tabulate and initiate control.

The computer may be an analog or digital type. Analog information has continuously varying values, for example; electrical voltage, mechanical position, temperature, speed, tension, frequency, or curve traces. Digital information utilizes numbers—discrete quantities—which always change in finite steps, for example; machine numbers, order number, date or code numbers. If information is available from a sensor in analog form, however, it can be changed to digital form using analog to digital converters.

The digital computer that has made its mark in industry today is the stored program computer. This computer takes its instructions and data from coded information in memory units and performs the computing functions as outlined above, whether this is for data processing or process control.

The industrial process computer system can scan analog or digital information from a great number of sensors; perform the necessary conversion of this information for processing in the computer; make the arithmetic or logical calculations in accordance with a stored program; initiate logging and display of significant operating and historical data; initiate alarm and/or control action to operate the process.

COMMUNICATING

Transmission of information is accomplished in many ways, from smoke signals—to the wink of an eye—to radar beams bounced off a distant planet. By definition, communicating is sending information from one point to another. The various forms include:

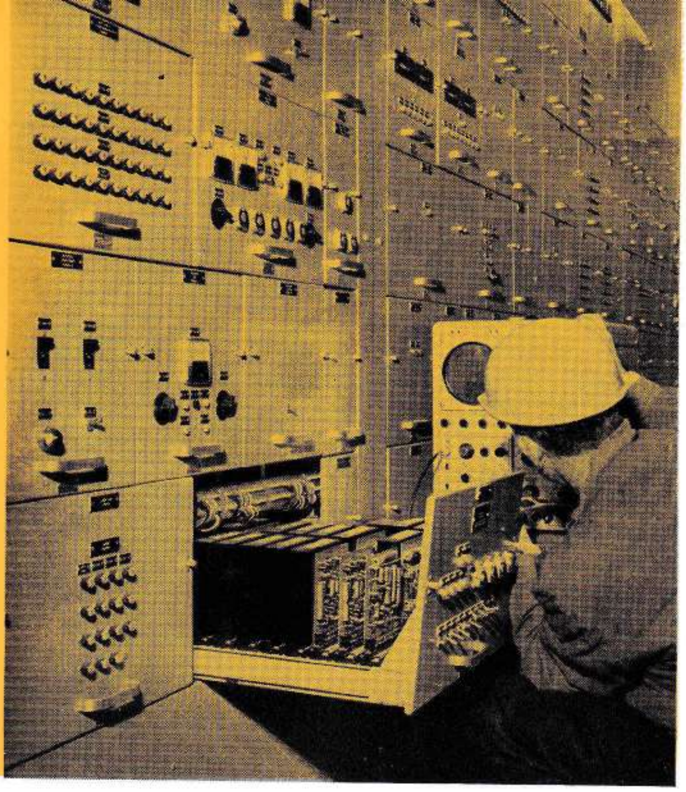
1. Wire signal for control signal, voice, or modulated signal including telemetering and carrier current.
2. Radiated energy through the air, such as radio, television, microwave or radar.
3. Optical, which includes cameras, projectors and light beams.

There are numerous means of transmitting a signal on these media including amplitude and frequency modulation, pulse code, pulses, width, pulse position or phase. The main point is that today, industrial-electronic technology provides for almost limitless means of communications.

CONTROLLING

The control function—whether it is a signal that initiates control of energy, an element that turns energy off or on, or a component that varies the transmission of power to an energy unit—can be classified into three broad categories: power actuating, regulating or programming.

Power actuators safely start and stop the energy system. Some 90% of all installed horsepower in American plants is electrical and the system elements used for controlling this horsepower include manual and magnetic starters, circuit breakers, field controls, motor control centers and static switches.



Directo-Matic control panel is part of the G-E program-control system for a steel plate mill. Static switching elements in drawer are readily accessible for testing.

Regulators maintain the energy units being controlled in accordance with a fixed or adjustable reference level. Regulating components include speed variators, amplifiers, position regulators, voltage regulators, and controllers that can operate from any measurable quantity such as temperature, speed, pressure or any of the sensors previously mentioned.

Programming is the performance of a sequence of operations, usually from prearranged information or instructions stored in some usable form. The familiar player piano is a good, simple illustration. Machine tools with numerical positioning control are modern examples of programmed industrial equipment.

Programs can be stored on punched tape, punched cards, magnetic tape, or in the future, thermoplastic tape. Other means of programming are through the use of timers, cam-actuated devices, or relay circuits operating in accordance with prearranged schedules.

Processes or functions also can be programmed based on measurements or conditions sensed during actual operation. An example is the computer-controlled start-up of a modern electrical power station. When predetermined values of speed, voltage, steam pressure, etc., have been reached, the system continues according to its programmed instructions.

The major point again is that today's products and technology permit a high degree of programmed automation for most business processes and functions.

DISPLAYING

Displaying is the presentation of information in some form suitable for use by human intelligence. The purpose of displayed information is to give an operator, engineer or business manager understandable information about the process or system. This information can then be used to make decisions affecting the process or system, or it can be used for simple monitoring, or it can be stored for later use.

In planning an integrated automation system, a detailed inventory must be made of the many forms of data display needed. As with other elements of the Information Flow System, the means of displaying information are practically limitless.

Generally, display is in either analog or digital form. But, displayed information also can be classified as visual, aural, touch or those senses to which humans respond.

Visual display includes pictures, words, numbers, symbols, analog indication, or color. The equipment for visual display includes television, projected image, typewriter, printer, counter, meter dial, oscilloscope, indicating light and many others.

Aural display might include radio, the sound part of television, alarms, music and telephone to name a few.

The other three human senses, touch, taste and smell, have minor application today.

One basic functional tool in the integrated automation system is data logging. While not precisely classified as display equipment, the data logger can handle large amounts of data efficiently and rapidly, displaying its actions or storing information for further processing by men and machines. A modern data logger is a highly flexible piece of equipment that can accept and present data in many forms, or store data for rapid access and future use.

PUBLICATIONS AVAILABLE FROM INTERNATIONAL GENERAL ELECTRIC

Industrial Power Systems—Bulletin GEA-7139, 48 pages, outlines principles of planning industrial power distribution systems for safety, reliability and economy while retaining flexibility and provisions for future expansion.

Shipboard Line of A-C Reactor Speed Control—Bulletin GEA-7202, 8 pages, gives data for control of marine cargo handling, offering custom-engineered adjustable alternating current speed drive control for specific customer applications.

Box Furnaces — Bulletin GED-4179, 4 pages, describes new box furnaces without cooling chamber with ribbon or silicon carbide resistors for operation in heat treating, tool rooms, heat treat department, laboratories or pilot operations.

Fluidized Bed Heat Treating Furnaces and Quench Baths — Bulletin GED-4306, 4 pages, describes the fluidized bed heat treating equipment for annealing, normalizing, solutionizing, aging, hardening, quenching, and isothermal transforming.

Size 00 Magnetic Contactors and Starters — Bulletin GEA-7304, 4 pages, describes new size 00 magnetic contactors and starters which have been added to G-E's 100 line and designed for low horsepower applications such as fans, blowers, conveyors and small pump motors up to 2 horsepower, 550 volts.

Industrial Soldering Irons — GEC-1545, 4 pages, describes G-E's complete line of production soldering irons for use on all electronic equipments, meters and instruments. Publication also covers special irons and transformers for soldering printed circuits, transistors, and miniature and sub-miniature components for aircraft assemblies.

AC Mine Load Centers for Underground Mining Applications—Bulletin GEA-7306, 2 pages, lists applications for G-E portable a-c power supply units rated 45 through 600 kva with a primary voltage of 2400, 4160 or 7200 volts and a secondary voltage of 480Y/277 volts.

Cabinetrol* Power Centers — Bulletin GEA-7080, 12 pages, provides data on Cabinetrol Centers for applications where standard motor starters are interlocked and sequenced with specialized control functions for operation of complex industrial processes.

New Type AB-30 180°-Scale Switchboard Instruments — Bulletin GEZ-3109, 4 pages, describes new line of low-cost a-c voltmeters and ammeters.

Copies of these publications are available from: Advertising and Sales Promotion Section, International General Electric Company, 150 East 42nd Street, New York 17, N. Y.

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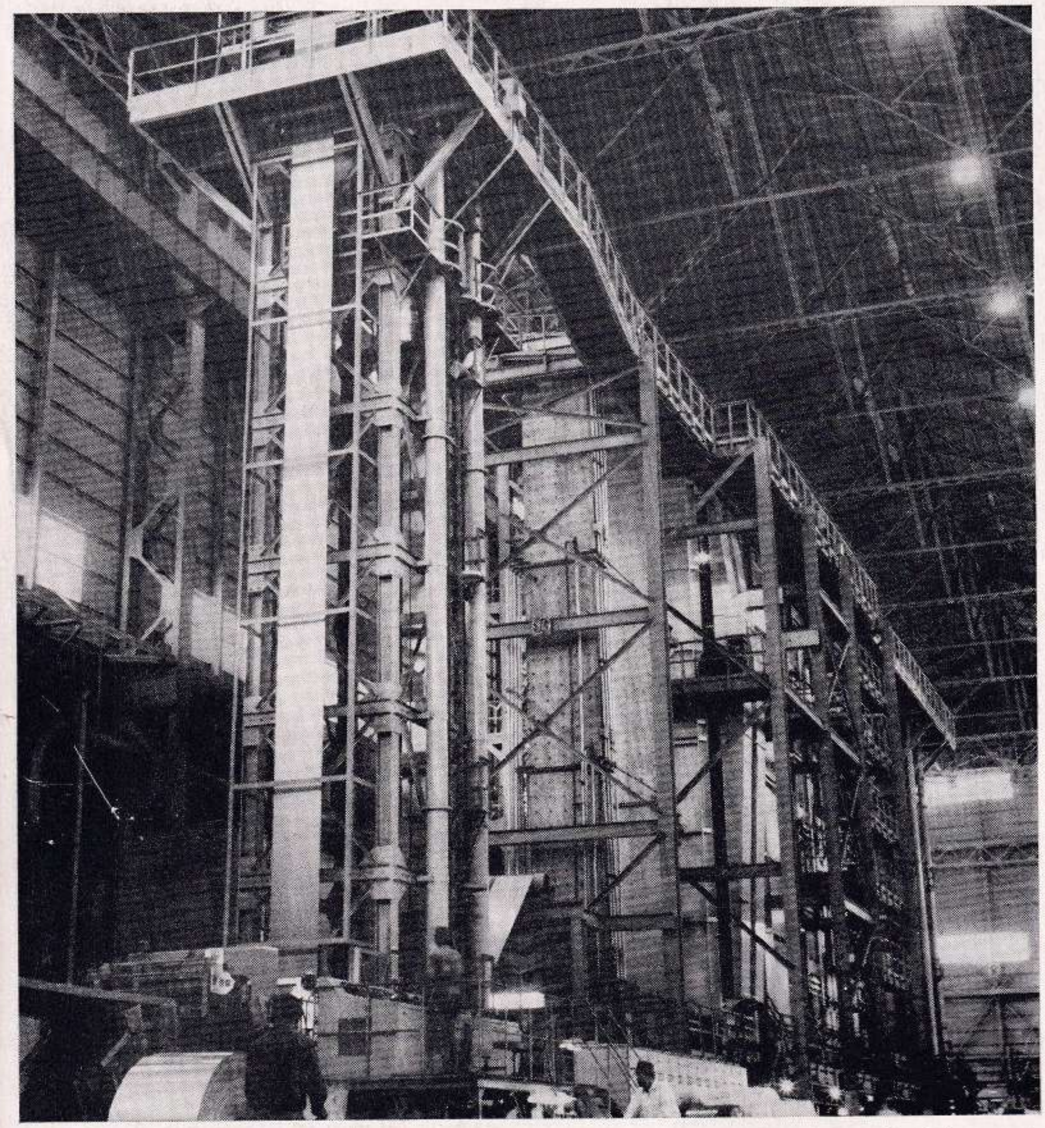

This is a General Electric combination gas and electric tower furnace viewed from the delivery end. It is used for the continuous annealing of tin plate steel strips in protective atmosphere at Fuji Iron and Steel Company, Japan. The furnace is rated 18TPH and 600FPM, designed for increase to 30TPH 1000FPM operation in the future. Vertical furnaces for continuous annealing permit higher output in a minimum of floor space, improved product quality, less handling, a shorter processing cycle and less in-process inventory then batch furnaces.

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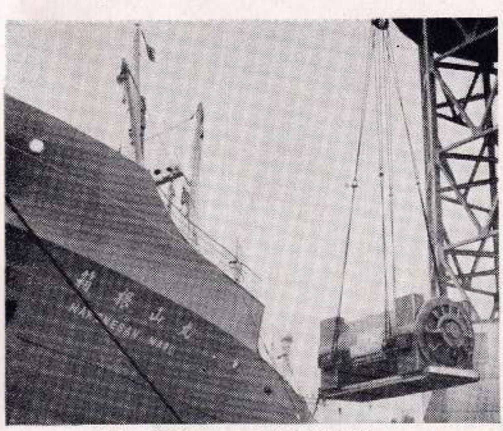
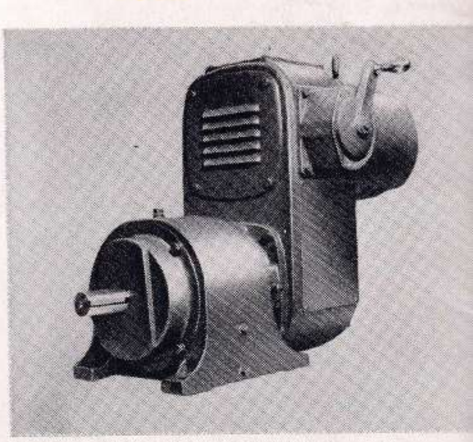


This 210-ton generator stator is one component of the General Electric 265,000-kw steam turbine-generator ordered by the Tokyo Electric Power Company, Inc. This giant turbine-generator is the largest ever exported from the U.S.A.

General Electric J79 turbojet has demonstrated its reliability by logging more Mach 2 flight time than any other engine in the free world. Typical of the J79's record is its outstanding performance in the Lockheed F-104 Starfighter—world record holder for high altitude and time-to-climb.



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